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INTERNATIONAL SCIENTIFIC NOTATION.

As pointed out recently in a letter in our columns, there is a great need for a scientific notation brought down to date, and we are glad to state that this is a subject which has been taken up for study by the International Electrotechnical Commission. As our readers will recall, this commission is the outcome of the St. Louis International Electrical Congress, which recommended the organization of two commissions to take cognizance of matters previously considered by the Chamber of Delegates at International Electrical Congresses—it having become apparent that this body had survived its usefulness of earlier days. One of these was an international commission to consist of two members appointed by the government of each country to be represented. Under the name of a "Conference" and with only semi-official character, several meetings have been held of a commission such as that recommended. The other recommendation was for the appointment by the various technical societies of the world of a representative commission to consider the question of "the nomenclature and ratings of electrical apparatus and machinery," and it was suggested that this commission should have a permanent secretary. About two years ago this recommendation was also put into effect by the organization of the International Electrotechnical Commission, and an arrangement was made whereby a number of the national electrical engineering organizations provide the funds for the maintenance in London of a Central Office, in charge of a permanent secretary. To return to our subject, each of the several national societies subscribing to the maintenance of the commission was requested some months ago to appoint a committee to study the subject of an international system of electrical nomenclature and symbols. The British committee entered on its work some time ago, and we understand that shortly the appointment of an American committee by the American Institute of Electrical Engineers will be announced.

It is now more than 20 years since the late Prof. Hospitalier commenced the ardent advocacy of an international system of symbols for physical quantities and abbreviations for units. After futile appeals before several international electrical congresses, he finally secured, at Chicago, in 1893, a recommendation from the Chamber of Delegates in favor of the system which he had compiled. This table of notations, while now somewhat incomplete through the advance of technical science, contains little that is radical, being based largely upon the notation of the earlier authoritative writers upon physical science; and as it has been very generally followed by writers in this country and in France, it is to be hoped that the commission will introduce few, if any, changes in the table. As the work which the commission has entered upon can scarcely escape extending into the general field of scientific notation, the question arises whether it would not be advisable, and even absolutely necessary for best results, to seek the cooperation of non-electrical professional and scientific bodies throughout the world in the preparation of a system that all can use in

common. Indeed, one can think of but few scientific terms that are exclusively encountered in electrical literature. Such co-operation would not be difficult with respect to this country and Germany, Austria and Switzerland, where there are bodies already organized for the purpose of establishing a system of notation that will be acceptable to all branches of physical science and its various technical applications.

The American body was organized in 1904 by appointment of members by the American Institute of Electrical Engineers, the American Chemical Society, the American Physical Society, the American Electrochemical Society, and the National Bureau of Standards, and has for secretary Prof. W. F. Magie, of Princeton University. In February of the present year, a commission representing a large number of professional and scientific societies in Germany, Austria and Switzerland, having an aggregate membership of more than 40,000, was organized for the study of, and report on, a system of standard scientific and technical notation for German-speaking countries, and is now engaged on its work, with headquarters in Berlin. As this body is highly representative not only of the electrical, mechanical and civil engineering professions of the countries named, but also of the chemical, electrochemical and "physical" branches of science, the desirability of entering into cooperation with it is obvious, if the aim is a system of notation for international usage. In the absence of any announcement of the scope of the present plans of the International Electrotechnical Commission in this connection, we can only hope that they will not conflict with cooperation with the other essential factors in the establishment of a truly international system of scientific and technical notation, and one which will meet with recognition in every branch of science dealing with the terms and quantities involved.

Unbalanced Loads in Two-Phase to Three-Phase Transformation.

An article by Mr. Bernh. F. Jakobsen on page 717 of this issue records an interesting general solution of a problem in phase transformation. The problem relates to the relative unbalance in the load on the three-phase primary side when the load on the two-phase secondary side is unbalanced. The extreme simplicity of the solution of the problem in a specific case will be appreciated if one considers first the maximum possible unbalance on the two-phase side; that is, with a certain load on one phase and no load whatsoever on the other phase. Evidently the load current on the three-phase side will be unbalanced; either the load currents in two lead wires will be equal in value and that in the third lead wire will be zero, or the load current in the latter lead will have a value equal numerically to the sum of the two currents in the other two leads, which two currents will be directly in time-phase with each other and with the load current in the third lead.

It is well known that if the load on the two-phase side is balanced, that on the three-phase side is balanced also, neglecting the small distorting effect of the local magnetic impedances of the several transformer coils. When the load on the two-phase side is only partially unbalanced, it may be considered as two loads, one in complete balance and the other in complete unbalance, and the effect of each on the primary quantities may be separately determined and then added (in proper time-phase relation) to obtain the resultant effect. In any event, and without any reference to the relative unbalance of the two-phase load or the relative time-phase position of the currents in the two secondary phases, the load current in one of the three-phase primary leads is equal in magnetomotive force and opposite in time-direction to one of the two-phase load currents; the current in one of the other leads is equal to the vector sum of one-half of this load current and a current equal in magnetomotive force and opposite in time-direction to the other of the two-phase load currents; while the current in the third lead is equal in magnetromotive force to the vector difference between the latter load current and one-half of the former secondary load currents. Only in case of exact equality in numerical value, and exact time-quadrature in phase position, of the two secondary currents are the three primary currents equal in value and displaced in phase by 120 electrical time-degrees. These facts are treated fully by Mr. Jakobsen in this issue.

The Measurement of Electrolytic Resistance Without the Use of Electrodes.

It is well known that the resistance of an electrolytic conductor, such as a tank of copper-sulphate solution, follows the same laws as that of a solid conductor. That is to say, it increases in proportion to the length, and inversely as the cross-sectional area; but the measurements of the resistance offered by an electrolyte are more or less influenced and interfered with by the polarization of the electrodes. If we try to measure carefully the resistance of a copper-sulphate tank between copper electrode plates, we find that there is a certain disturbing e. m. f., or at least a c. e. m. f., of polarization which affects the measurement, and makes the resistance appear either greater or less than its real value. For this reason alternating currents are commonly employed in the measurement of electrolytic resistances. Another method, which has been tried at different times, is to avoid the use of electrodes altogether, by employing closed ring glass tubes, filled with the solution under test, and determining the alternating-current strength which can be induced by an alternating magnetic field in such a ring. A series of measurements of electrolytic resistance without the use of electrodes, by Messrs. W. S. Franklin and L. A. Freudenberger, appears in the last number of *The Physical Review*. The electrolytic solutions under test were contained in a glass ring tube enclosing the core of a small transformer. The electrolytic conductor thus formed a secondary winding of a single turn. The effect of this closed secondary circuit of fairly high resistance was to alter the apparent impedance of the primary winding by a certain small amount. A similar transformer with an adjustable resistance in the secondary circuit was balanced against the electrolytically loaded transformer with the aid of a special alternating-current galvanometer in a Wheatstone bridge arrangement. The method forms an interesting check upon the usual method of measurement with electrodes, but does not seem to have possessed a high degree of sensitiveness in the case reported.

Comparisons of National Light Standards.

In the early days of electric lighting, the desirability of an international standard of candle-power or luminous intensity was soon manifest. The standards of light employed in 1880 by different countries were diverse and indefinite. For example, Great Britain held to her parliamentary candle of spermaceti

⅞ in. in diameter or six to the pound, and burning away at the rate of 120 grains per hour. Occasional variations in the horizontal intensity of this standard candle reached 30 per cent. In 1884, the International Conference of Electricians in Paris adopted an international unit of light, which was named the violle, and which was defined to be the light emitted perpendicularly from 1 sq. cm. of platinum at the temperature of its solidification. As this unit was rather large, the International Electric Congress of 1889 adopted the "bougie décimale," or decimal candle, as an international standard, and which was defined as the one-twentieth of the violle. The intentions of the International Conference of 1884, and of the International Congress of 1889, in regard to a uniform light standard were excellent; but, unfortunately, the art of photometry had not reached the state of development necessary for the execution of the project. The various delegates went home rejoicing in the supposed possession of an international decimal candle defined in terms of the violle. When, however, they tried to reproduce the violle, each in his own laboratory, the variations discovered were serious and disconcerting. Molten platinum is not an easy substance to work with, and very small degrees of impurity effect appreciable changes in the luminous emission from its glowing surface. The result was that the attempt to bring about a uniform international candle was a failure. France alone of all the countries represented has clung faithfully to the bougie décimale, and still retains it; but even France has not claimed to perpetuate this decimal candle through the instrumentality of the fundamental standard violle and its square centimeter of glowing freezing platinum. She has maintained the bougie décimale through the medium of her standard carcel lamp burning 42 grams of pure rape-seed oil per hour. It is claimed by carcel-lamp experts that under proper conditions this flame standard of light can be relied upon to be reproduced within about 1 per cent. The normal carcel has been accepted in France as the lighting equivalent of 9.6 bougie décimales.

The other countries represented in the congress seemed to have been so discouraged with the non-success of the violle primary standard that they gave up for the time all hope of adhering to an international candle, decimal or otherwise. They set to work to find a standard of light that would be reproducible to a satisfactory degree of accuracy. In England, the pentane flame standard was produced, in Germany the amyl-acetate flame standard, and in France the colza-oil flame standard, as already mentioned. Each standard has its advantages and disadvantages. Experts trained exclusively to the use of one frequentaly extol its particular praises and sigh doubtfully over the precision of the others. It is now generally admitted that the best of these three flame standards is likely to vary at different times with one and the same observer to the extent of 1 per cent, and with different observers more. It is also generally agreed that suitably selected and aged incandescent lamps are much more reliable standards for reproducing a given candle-power than any flame standard can be. Consequently, any one laboratory can maintain an assigned candle-power once established through comparison of such secondary incandescent lamp standards. It is only necessary to re-establish the terminal voltage on the lamp with the aid of an accurate voltmeter and the candle-power in a given direction becomes re-established, if the lamp is not worked too long.

About the year 1893, the incandescent lamps of American manufacture became commercially standardized in terms of the nominal British parliamentary candles of that date through measurements at Charlottenburg, which established a mean ratio of one hefner amyl-acetate standard equal to 88 per cent of the British parliamentary candle. This ratio has since been accepted both by the American Institute of Electrical Engineers and by the national Bureau of Standards. In England, however, the British parliamentary candle has been allowed to burn out, and it is now accepted as the tenth part of the Vernon-Harcourt 10-candle pentane flame standard. According to measurements made both at Kew and at Charlottenburg, this new concrete standard of the British candle is nearly 4 per cent feebler than the original representative in spermaceti as determined in Charlottenburg. The gas photometric standards in America are also Vernon-Harcourt pentane standards, and it would seem that the unit of candle-power maintained in the best gas photometric laboratories of the United States is a few per cent less than that maintained by the electric lamp manufacturers. In other words, an incandescent lamp of 16 mean horizontal candle-power in the United States is said to correspond to what the gas industry would rate at 16.5 candles, or thereabouts.

An international congress on photometry met this year in Zurich, as already mentioned in our editorial and digest columns of the issue of Sept. 21. This congress adopted a ratio of one hefner equal to 91.3 per cent of the new British candle and equal to 93 per cent of the carcel. This means that the United States standard candle-power is a couple of per cent more than the French bougie décimale and nearly 4 per cent more than the new English candle or than the United States gas candle if the latter conforms to Vernon-Harcourt pentane standard. These discrepancies would be quite immaterial if incandescent lamps were not under comparison, because comparison tests of flame standards or of glow-lamps against flame standards might readily vary within those limits. Incandescent lamps of the same specific consumption can, however, be calibrated and compared to less than one per cent, so that it becomes desirable to restore, if possible, the international bougie décimale. This seems to be about midway between the British and American candles, and only a couple of per cent of change would have to be made by any of the three countries, England, France and America, in order to secure uniformity. The uniformity could only be reached through international action, and could only be maintained through the regular interchange of standard incandescent lamps between the national laboratories as suggested recently in an excellent paper by Dr. Hyde. Instead of having four different units of candle-power in the four countries mentioned, this international adjustment would leave only two outstanding, namely the hefner and the bougie. It would be very desirable to have only one instead of two; but the difficulties in the way of a readjustment to that effect would be much greater and perhaps irremovable. It would mean more than 5 per cent all round, a distinct commercial disturbance, particularly for Germany, which would be placed at a disadvantage, because a 21-hefner lamp would become reduced below 20 candles. On the other hand, the readjustment to the bougie between England, France and America would probably be too small to be commercially objectionable.

Annual Meeting Empire State Gas & Electric Association.

The annual meeting of the Empire State Gas & Electric Association was held on Oct. 2, at the Edison Auditorium, New York City, Vice-President Carleton Macy in the chair, the president, Mr. E. H. Palmer, being absent from serious illness. An interesting message was read from him, however, dealing with the work of the association. The reports presented during the day by Mr. C. H. B. Chapin, the secretary, showed that the association had increased from 48 members to 69 at the present meeting.

Mr. H. H. Curran, of Curran & Mead, presented a very interesting report as to the publicity work done for the association during the year, and a number of examples were submitted of the work done in sending out articles to the press as to the work of the association—municipal ownership failures, electrical advances and other cognate matters. Quite an interesting discussion followed as to this work and its real value to the members.

Mr. W. W. Freeman, of Brooklyn, then presented the report of the public utilities committee and its work in watching the action of the new Public Service Commission. One of the cases to which the committee was giving attention was that of the Watertown Light & Power Company, which is now appealing from a decision of the old commission limiting securities to a point considerably below the actual investment of the company. The case is expected to go before the courts in November, when it will be seen what they have to say to the power of the commission to enforce such a limitation. Reference was also made to the order of the former commission fixing 15 cents as the maximum kw-hour charge to be made by the Rockland Light & Power Company in Orangetown. It was shown that this order was a restraint of trade and a suppression of the natural law of supply and demand. Out of 112 customers served at a loss, 75 would receive service at a greater loss, and out of 26 served at a profit, 19 must be served at an increased profit to make good the increased losses. It is hoped and believed that under the new commission such orders will not be issued. The case was also referred to of the Newburgh Light, Heat & Power Company, where an application for an issue of $250,000 preferred cumulative 8 per cent stock had been denied. Mr. Beal, of that company, explained that the object had been to strengthen the character of the issue, making it more attractive to the stockholders. The attitude taken appeared to be one broadly of objection to such a kind of issue because, not in this case, but in others it might settle on the community a definite future obligation which would require the raising of that dividend through higher prices for gas and electricity, working a hardship on the community. If the cumulative feature had been left out it would have gone through. The application will be renewed.

Mr. Freeman referred also to the situation at Saratoga, where Senator Brackett, representing the company, had raised the contention that the Legislature had not the right to delegate such powers as fixing rates to these commissions; and if this was sustained it would do away with the present law and the commissions. Mr. Searle and others made the point that the idea could not be too strongly fought that companies should be limited to 6 or 8, or even 10 per cent if they could earn it by good management and give good service.

Mr. Freeman emphasized the importance of setting aside a certain sum for depreciation regularly, as an item of cost, and paying dividends only out of what was left over. The Brooklyn Edison Company this year is charging up a sum equal to one-half of 1 cent on each kw-hour sold, as an element of replacement and depreciation. It is now replacing a feed-water plant, charged against the account, and when it comes before the commission it will be recognized that the $350,000 or $400,000 item was an expense, and not in any sense part of the profit.

Mr. R. A. Davidson presented a report from the committee on insurance, which said it was not able at the present juncture to present any scheme of mutual insurance. The report said:

"In connection with the handling of insurance for various corporations' interests, it has been deemed desirable by the insurance companies to perfect an organization for the following purposes:

"First.—For inspection of properties in a thorough manner by engineers competent to pass upon desirable improvements.

"Second.—To negotiate with the assured to secure the improvements, and where necessary to take actual oversight of such improvements.

"Third.—To secure uniform rules and submit definite assurances of rate for the improvement affected.

"Fourth.—To bring about closer relations between the organizations representing the assured and the insurance companies, and to co-operate with such organizations in the development of standards for construction and elimination of fire hazards which will be satisfactory to all interests.

"Fifth.—To secure uniform rulings on forms, and to assist the assured in placing their accounts in desirable companies not crippled by conflagration losses or affected by wilful violations of state laws or doubtful foreign ownership.

"Sixth.—The magnitude of the entire subject, and its growing importance renders immediate action and careful consideration of the entire subject necessary by organizations as vitally interested as are electric and gas lighting combinations.

"Seventh.—Detailed advice on all improvements and new construction should be furnished these interests without the same ownership having to consult through a dozen different channels; in other words, it is earnestly recommended that some one source of information be supplied them through which they can discuss the various items suggested above."

Mr. Davidson added: "We have also received propositions from insurance brokers looking toward a uniform inspection and rerating of risks. We believe that without doubt some general scheme for placing insurance through a central source can be worked out which will greatly benefit the members of this association, and looking toward that end, we ask that this committee be continued and permission be given to obtain from the members of the association the necessary confidential information to enable us to work out the details properly."

Mr. Cole criticized the chaotic conditions among the companies themselves in that they are sending out independent inspectors, often incompetent, in addition to the regular state inspectors; and instances were cited at Elmira and elsewhere of such work.

The presentation of the treasurer's report brought up a discussion as to the value and heavy cost of the publicity work, on which $4,500 was expended. The other work of the association took about $1,700. It was pointed out that unjust publicity had cost members very large sums of money, and it was argued that good publicity checked all that. Mr. T. C. Martin pointed to the extraordinary subsidence of the municipal ownership agitation as one proof that the publicity work had had desired effect. Mr. W. H. Gardiner confirmed this.

The afternoon session was mainly devoted to papers and written reports, among them one by Mr. A. E. Forstall on "Gas Standards." Mr. L. C. Palmer presented a paper on the methods that public utility corporations should advocate as a basis for taxation. He said:

"At present we are taxed by the state on our gross earnings, one-half of 1 per cent. This is purely a state tax. If this plan of assessment is fair, equitable and desirable for the state to base its claims for its share of our tax, why should it not be equally fair, equitable and desirable as a basis on which to assess general utility corporations in the municipalities and counties? In addition to this we are again taxed by our city, school and county, and the valuation for these latter taxes is fixed by the tax commissioners regardless of the rate of taxation. In some cities the rate closely approximates 3 per cent, and utility companies are compelled to pay this rate upon whatever valuation the tax commission places upon the franchises and tangible property in the streets and alleys, besides

paying their regular real estate tax upon their plants proper, making the load very burdensome to carry. There is no question about the constitutionality of the state right to tax special franchises, which include the main and wire systems of gas and electric companies, that are in the streets, alleys or public places, but there should be some unit of value as a basis. At present there is none. If in the city above quoted as having the $40,000 assessed valuation, its property was in just proportion to that in the city that was assessed at $140,000, it would be all right, but such is not the case—and here comes in the trouble, for the franchise valuation in the city of the $40,000 assessed valuation is much more valuable than in the one whose assessed valuation is $140,000. In the writer's opinion, if we could pay our taxes upon our gross earnings, then each company would stand its just proportion of the taxes. The company selling $100,000 worth of its product would then pay taxes upon that basis, and another, selling only one-half as much of its commodity, would be taxed only one-half as much; while under our present system of assessments the earnings of a company make but little difference in the amount it is compelled to pay in taxes, as some very valuable properties are assessed much less than others not nearly so valuable. A property's value is its earning capacity, or what it can be made to earn, hence it should be taxed upon what it actually does earn and not upon what a few disinterested commissioners may think it advisable to place upon it, whether it can afford the amount or not. These commissioners do not know the circumstances under which each plant is laboring, but they can know how much our earnings are, and if I earn $100,000 per year, I should pay taxes upon that amount, and my neighbor earning $50,000 should pay taxes upon that amount only, then we would have a uniform taxation, and each general utility corporation would bear its just proportion of the public expenses."

Mr. Gardiner discussed this briefly as a member of the public policy committee of the National Electric Light Association, which combated the belief that a special tax should be paid for the use of the streets, as unfair to the consumer of service as against the non-consumer. "The use of the streets is practically free to every one. The modern gas or electric company transports energy equivalent to thousands of tons of coal over or under the public streets without wear and tear on these streets, without maintenance expense to the city, without interference with other traffic, without noise and nuisance to the public living along the streets, and with less detrimental incumbrance to the streets than could be done in any other way. If anybody is entitled to special consideration and advantage it seems to us that the user of this service should receive some advantage over the user of other forms of energy which require transportation in a manner that encumbers the public thoroughfares and subjects other people to interference, noise and nuisance, and also subjects the streets to unnecessary and expensive wear.

"In street railway service the same thing is true, but in a lesser degree. The taxes imposed upon quasi-public corporations are simply shifted to their consumers, as the company's ability to lessen the cost of its service is lessened to that extent, and in the case of street railway service it means that the users of the cars are paying more than their fair proportion for the maintenance of the public highways. If the public cars hold on an average 30 people, it means less interference with traffic than would 30 individual conveyances.

"We believe that the theory of franchise taxation is in error, is against the interests of public policy, imposes burdens where they do not belong, and in the street railway business imposes burdens on the poorer class of people, whom, as a rule, the public wishes to protect and favor in all other methods of taxation."

It was voted, after further discussion, that the chair appoint a standing committee of three on taxation, and to investigate the subject of the taxation of franchises.

Mr. R. M. Searle presented the report of the meter committee detailing the work done to secure data as to meters used by companies and the nature of testing. The committee approved the following recommendations:

1. That it be recommended to the commission the acceptance of certain or all types of meters, and all new types to be submitted to the commission.

2. That it be recommended to the commission that they continue to deal with the inspection of individual meters as they now do until a practical manner of carrying out the feature of the law can be evolved.

3. That the commission be requested to fix on as small a charge as possible for the services of their representative to supervise the test of all meters complained of by consumers on consumers' premises.

4. That the following section of the law be printed at the top or on the back of each billhead, together with the resolution of the commission fixing the charge for the services of the commission's representative, and an example of the blank billhead and the manner of charging for services be submitted to the commission for their information and approval:

"If any consumer to whom a meter has been furnished shall request the commission in writing to inspect such meter, the commission shall have the same inspected and tested; if the same on being so tested shall be found to be 4 per cent if an electric meter, or 2 per cent if a gas meter, defective or incorrect to the prejudice of the consumer, the inspector shall order the gas or electrical corporation forthwith to remove the same and to place instead thereof a correct meter, and the expense of such inspection and test shall be borne by the consumer. A uniform reasonable charge shall be fixed by the commission for this service."

5. It is suggested that companies send to the commission a statement once a month of tests on complaint of meters.

6. That a sub-committee of three report to the general committee at its next meeting upon a feasible method of supervising company's standards and tests of consumers' meters; the committee to consist of the chairman and such others as he may select to be associated with him.

7. It is suggested that a sub-committee be appointed to answer the only question asked by the commission at the meeting on Aug. 29, 1907, and which was not completely answered at that time, that is: "The number, the causes, the kinds, the number discovered on complaint as well as discovered by company, of meters running fast." The committee to consist of Mr. Arthur Williams, of Yonkers, chairman; Mr. R. M. Searle, of Rochester, and Mr. C. W. Cunningham, of Elmira, and that this sub-committee report at the next meeting of the general committee.

Mr. W. W. Cole presented a brief paper on the agitation for underground distribution in place of overhead, an abstract of which will be printed in a subsequent issue. Mr. E. L. Elliott then read an excellent paper on "Buying and Selling Illumination," in which he advocated the utility of illuminating engineering. The discussion in the paper was directed chiefly to street lighting. An abstract of Mr. Elliott's paper will be printed in a later issue.

The next paper on the programme, "Municipal Ownership in New York State," was read by Mr. Glenn Marston, and was a very forceful treatment of the subject, advocating vigilance and activity against the movement.

Messrs. T. R. Beal, L. C. Palmer and S. C. Bradley, Jr., were appointed a standing committee. The following officers were then elected unanimously: Mr. S. C. Bradley, Jr., president; Mr. P. J. Glidden, vice-president; Mr. T. C. Horton, treasurer. There were added to the executive committee Messrs. A. Williams, W. T. Morris and R. M. Searle.

Manufacture of Metallic and Other High-Efficiency Filament Lamps.

Two patents have recently been issued in Great Britain to the British Thomson-Houston Company, the representative in Great Britain of the General Electric Company, on the manufacture of metallic and other high-efficiency filament incandescent lamps. The more general patent states that the process described is applicable to a great variety of refractory metals and materials,

such as tungsten, molybdenum, boron, zirconium, titanium and compounds or alloys of any of these, or of other materials of the same general refractory nature. These materials are impregnated with less refractory metals or alloys, such as copper, cadmium, gold, silver, mercury, bismuth, tin, and various other of the well-known metals having vaporizing compounds approximating to these, and the alloys of these metals may also be used. In general, the less refractory metals are introduced in the pores of the refractory material and serve to give the body ductility and strength, and in some cases to increase its electrical conductivity. The ductile or alloy melting metal is retained in this condition until the body has been worked or formed into the desired shape, and it is then driven out by heat treatment, leaving behind a refractory wire rod or filament.

The specification then proceeds to describe the process which involves the use of an electric furnace for effecting the impregnating process. A rod of pure tungsten pressed into shape under heavy pressure passes through an airtight joint into a chamber at the bottom of which is placed a quantity of the ductile metal amalgam or alloy with which the tungsten is to be impregnated. In utilizing the apparatus the air is first exhausted from the chamber and then the tungsten rod lowered until its end makes contact with the liquid metal, after which it is elevated and an arc established between the rod and the vaporizing metal at the bottom of the tube. Excluded air and other gases given off during the process are then exhausted from the chamber so that after some minutes of operation the tungsten rod is in a clean and porous condition, and then the rod is suddenly lowered into the liquid metal, which percolates through the pores and completely fills up all the minute spaces in the rod. The impregnated rod is then withdrawn from the liquid and, after cooling, is smooth and strong and has a fine, even fracture and can readily be polished. Tungsten impregnated with silver or cadmium is white; while tungsten and the other refractory metals become yellow or salmon-colored when impregnated with copper. The impregnated rod may then be subjected, without further treatment, to the consolidating action of a high current, and if the current is properly applied, the resultant rod is much stronger and better suited for use as glowers than the original pressed or untreated material. Moreover, the impregnated rod may be rolled, drawn or extruded, much like pure metals of pure ductility, and can be converted into filaments of essentially the size now used in incandescent lamps. In the latter case, the filament is treated with electric current, as in the case of the rod.

The claims of the patent are on the process of impregnating the material, of forming it into a body of a required shape, and subsequently passing an electric current through the body to eliminate the fusible components.

The second patent relates to a method of producing pure boron, suitable for the production of rods for lamps and furnaces, which consists in heating a boron compound, such as nitride, in an inert environment to a temperature sufficient to decompose the compound and yield pure boron. In the process the apparatus described in the first-mentioned patent is in part utilized. The claims relate to the production of conductive boron by the decomposition of a boron compound, such as nitride, by heating to a temperature of about 15 degs. C. in a vacuum furnace.

The Street Railway Convention at Atlantic City.

Beginning Monday, Oct. 14, the American Street & Interurban Railway Association, with its allied societies, will hold its annual convention at Atlantic City, and the meetings will be spread out over the week until the 18th. The meetings of the parent organization and the engineering association will be held in the sun parlor near the end of the Steel Pier, on which, also, the fine customary exhibit of apparatus will be made. The accountants will have their meetings at the Chalfonte Hotel, and the claim agents will be in session at the St. Charles. During the week there will as usual be various entertainments, but it is understood that owing to the local conditions pertaining at a seaside resort at this season of the year, the banquet will be omitted. A very large attendance is expected, and the hotel reservations have been extremely heavy. Secretary Swenson announces the following programmes for the various societies:

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION.

Wednesday, Oct. 16, 1907—9:30 a. m. to 1 p. m.; convention called to order; address of welcome, president's address, report of executive committee, report of secretary and treasurer, addresses by presidents of affiliated and allied associations, announcements, new business. Reports of committees: (a) membership, (b) compensation for carrying mail, (c) subjects, (d) car wiring, (e) standardization of equipment. Paper—"The Technically Trained Man and the Electric Railway Profession," by Prof. H. H. Norris, Cornell University, Ithaca, N. Y.; paper—"The National Fire Protection Association and Its Work in the Street and Interurban Railway Field," by Ralph Sweetland, Boston, Mass.; paper—"The influence of the Design of Railway Structures on Economy of Operation," by H. J. Campion and William McClellan, consulting engineers, New York, N. Y.

Thursday, Oct. 17, 1907—9:30 a. m. to 1 p. m. Appointment of nominating committee; reports of committees: promotion of traffic, rules, heavy electric traction. Paper—"Light Freight Handling by Electric Lines," by P. P. Crafts, general manager Iowa & Illinois Railway Company, Clinton, Iowa; paper—"Freight Service on Electric Railroads," by H. H. Polk, president Interurban Railway Company, Des Moines, Ia.; paper—"A Department of Publicity," by J. Harvey White, advertising manager Boston Elevated Railway Company, Boston, Mass.; paper—"Advertising from the Street Railway Standpoint," by A. W. Warnock, general passenger agent, Twin City Rapid Transit Company, Minneapolis, Minn.; paper—"The Problems of a Small Road," by H. S. Cooper, Manager Galveston Electric Company, Galveston, Tex.; paper—"The Use of T-Rails in Cities," by C. Gordon Reel, Vice-President Kingston Consolidated Railway Company, Kingston, N. Y.

Friday, Oct. 18, 1907—9:30 a. m. to 1 p. m. Reports of committees: (a) insurance, (b) rules for the construction of modern car houses, (c) municipal ownership, (d) public relations; paper—"Public Policies of the Past and Future," by C. Loomis Allen, Vice-President Utica & Mohawk Valley Railway Company, Utica, N. Y.; paper—"Interurban Railway Fares," by Theodore Stebbins, J. G. White & Company, New York, N. Y.; discussion—"Reduced Fare Agitation;" discussion—"Depreciation from the Financial and Managerial Standpoints;" report of nominating committee and election of officers. During this session, also, Mr. W. J. Clark, of the General Electric Company is to present a paper on "Municipal Ownership in Great Britain and the United States."

AMERICAN STREET AND INTERURBAN RAILWAY ACCOUNTANTS' ASSOCIATION.

Tuesday, Oct. 15, 1907—10 a. m. to 1:30 p. m. Convention called to order; address—John I. Beggs, president American Street & Interurban Railway Association; annual address of president, annual report of executive committee, annual report of secretary-treasurer; paper—"Park Accounting," by Frank J. Pryor, Jr., comptroller the American Railways Company, Philadelphia, Pa.; question box, edited by Frank R. Henry, auditor, United Railways Company of St. Louis, St. Louis, Mo.; appointment of convention committees; new business. Two p. m. to 5 p. m., luncheon and social afternoon.

Wednesday, Oct. 16, 1907—9:30 a. m. to 1 p. m.; joint meeting with "American" association (on Steel Pier); 3 p. m. to 6 p. m.; paper—"Mechanical Devices for Office Use," by F. E. Smith, auditor Chicago Union Traction Company, Chicago, Ill.; report of committee on "Standard Classification of Accounts and Form of Report;" report of committee on "International Standard Form of Report."

Thursday, Oct. 17, 1907—10 a. m. to 2 p. m.; paper—"Where Maintenance Ends and Depreciation Begins," by J. H. Neal, auditor of disbursements, Boston Elevated Railway Company, Boston, Mass.; reports of convention committees; election of officers; installation of officers.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION.

Monday, Oct. 14, 1907—9:30 a. m. to 12:30 p. m., registration at Steel Pier; 2 p. m. to 5 p. m., convention called to order; address—John I. Beggs, president American Street & Interurban Railway Association; reading of the minutes of last meeting; address of the president; annual report of the executive committee; annual report of the secretary-treasurer; appointment of convention committees; reports of special committees; report of committee on "Control Apparatus;" report of committee on "Maintenance and Inspection of Electrical Equipment."

Tuesday, Oct. 15, 1907—9:30 a. m. to 12:30 p. m.; report of committee on "Way Matters;" paper—"Care of Electric Railway Tracks," by George L. Wilson, Engineer Twin City Rapid Transit Company, Minneapolis, Minn.; paper—"Rails and Joints as Affected by Traffic in New York City," by W. Boardman Reed, engineer, New York City; report of way committee on "Rails Corrugation Investigation;" report of committee on "Concrete Tie Investigation;" report of sub-committee on "Rail and Rail Matters."

Tuesday, Oct. 15, 1907—2 p. m. to 5 p. m.; report of "Committee on Standardization;" report of committee on "Open vs. Closed Terminals for Car Storage;" report of committee on "Operating and Storage Car House Designs;" question box.

Wednesday, Oct. 16, 1907—9:30 a. m. to 1 p. m.; joint meeting of American Association and Allied Associations.

Paper—"Gas Engines," by Paul Winsor, chief engineer motive power and rolling stock, Boston Elevated Railway Company, Boston, Mass.; paper—"Gas Engine Operation," by W. W. Cole, general manager Elmira Water, Light & Railway Company, Elmira, N. Y.; paper—"Steam Turbines," by St. John Chilton, engineer, Allis-Chalmers Company, Milwaukee, Wis.; paper—"Steam Turbines," by August H. Kreusi, engineer, General Electric Company, Schenectady, N. Y.; paper—"Recent Developments in Steam Turbine Power Station Work," by J. R. Bibbins, engineer, Westinghouse Machine Company, East Pittsburg, Pa.; general business; election of officers.

The claim agents' association will have its meetings on Monday, Tuesday and Wednesday.

Test of a 7500-kw Steam Turbine.

An eight-hour economy test was made Sept. 1 by the New York Edison Company, through its chief engineer, Mr. J. P. Sparrow, of a 7500-kw Westinghouse-Parsons steam turbine in Waterside Station No. 2. While rated at 7500 kilowatts, the turbine has a maximum output of 11,250 kilowatts. Under 175 lbs. of steam pressure, 28 ins. vacuum, and 100 deg. superheat, the turbine unit was guaranteed to have a minimum steam consumption of 15.9 lbs. per kw-hour at the generator terminals, with a normal speed of 750 r. p. m. The electrical efficiency of the generator was guaranteed to be 97.8 per cent, exclusive of friction and windage at the test load. The results of the tests showed a consumption about 7.5 per cent less than the guarantee.

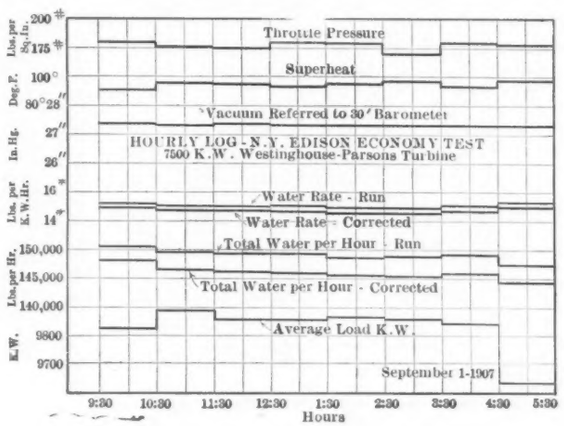
During the tests the turbine carried practically 70 per cent of the 25-cycle load of the station. The load on the turbine was maintained as constant as possible by remote control of the turbine governor by the switchboard operator, the maximum variation of the load being held within 4 per cent above and below mean, except during the last hour, when the load decreased somewhat. Previous to the test, the turbine unit had been running on a load of 7000 kilowatts, which was increased to the test load 10 minutes before the start.

The electrical load was measured by the two-wattmeter method, using instruments of the standard laboratory type, which were calibrated at the New York Electrical Testing Laboratories immediately before and after the tests. The power-factor was maintained substantially at unity, and the electrical readings were taken at one minute intervals. All water of condensation was weighed at intervals of five minutes. The circulating pump drew salt water taken from the East River, and condenser leakage was determined entirely by chemical analysis, employing the silver nitrate test with a suitable color indicator. This method is stated to have proved extremely sensitive, and had the advantage of making it possible to discover any change in the rate of condenser leakage taking place during the tests, whereas the method of weighing the leakage accumulated during a definite period, when the condenser is idle and under full load, provides only an average result during the period. The water level in the hot well was maintained at a practically constant point. Steam pressures and temperatures were determined close to the turbine throttle and the degree of superheat was obtained in the usual manner.

The following data represent the results of the tests, calculated for instrumental errors only:

Duration of test	9:30 a. m. to 5:30 p. m.
Average steam pressure at throttle, lbs. per sq. in. gauge	177.5
Average superheat at throttle, degrees F.	95.74
Average vacuum (referred to 30 ins. barom.), ins. mercury	27.31
Average load on generator, kilowatts	9830.48
Average steam consumption, as tested, lbs. per kw-hour.	15.15

Owing to the departure during the test from specific operat-



CONSUMPTION TEST OF STEAM TURBINE.

ing conditions upon which guarantees were based, it was necessary to correct the observed results by the following amounts:

Pressure (2.5 lbs. high) correction, 0.25 per cent; vacuum (0.69 in. low) correction, 1.84 per cent; superheat (4.25 deg. low) correction, .29 per cent. These corrections when applied to the observed steam consumption given above gave the following results, representing contract conditions:

Average corrected water rate during eight-hour tests, 14.85 lbs. per kw-hour. The guaranteed water rate was 15.9 lbs. per kw-hour.

The accompanying chart represents the results segregated into hourly periods. It will be noted that the load was considerably lower during the first and last hour than during the main part of the test. Neglecting these two hours and considering only the six hours' period from 10:30 a. m. to 4:30 p. m., the results are as follows:

Average corrected water rate, 14.8 lbs. per kw-hour.

Equivalent water rate, 10.65 lbs. per brake hp-hour.

Equivalent water rate, 9.8 lbs. per indicated hp-hour.

The two latter quantities are determined by applying conversion factors for generator efficiency and for internal losses.

Compared with the results previously obtained from tests of machines of similar design installed in the Manhattan Station of the Interborough Rapid Transit Company, New York, and the Long Island City Station of the Pennsylvania Railroad, at the same loads and with equivalent operating conditions, the several performances are almost identical.

CURRENT NEWS AND NOTES.

AMERICAN ELECTROCHEMICAL.—The American Electrochemical Society will hold its meeting in New York City Oct. 17 to 19, as already announced, full details of the programme having been given in these pages last week.

OHIO TELEPHONE INDEPENDENTS.—The executive committee of the Ohio Independent Telephone Association, at a meeting a few days ago, decided upon the following places and dates for the district meetings: District No. 1, Cleveland, Nov. 8; No. 2, Canton, Nov. 19; No. 3, Zanesville, Nov. 20; No. 4, Newark, Nov. 21; No. 5, Washington C. H., Nov. 22; No. 6, Toledo, Dec. 3; No. 7, Lima, Dec. 4; No. 8, Dayton, Dec. 5; No. 9, Hamilton, Dec. 6. District officers will be chosen at these meetings and delegates elected to attend the meeting of the International Independent Telephone Association. While it was announced some days previous to this meeting that the proposed negotiations between the Bell and the Independent people relative to Bell competing exchanges would be taken up, nothing furthur than a discussion of the subject took place. It is said that the question will be taken up at some future meeting of the committee.

A SWINDLER ABROAD.—It has been brought to our attention that a man who some time ago defrauded a number of members of the electrical and mechanical industries in this country has recommenced operations, and we therefore deem it advisable to republish his description and warn our readers against him. He is a very plausible Englishman, about 30 years of age, 5 ft. 7 or 8 ins. in height, of slight build, light complexion, has crooked teeth, and generally represents himself as the son of some large manufacturer or other important man in England. He is very well informed as to the names of products and manufacturers on both sides of the Atlantic, and as a rule, after gaining the confidence of the man upon whom he calls, tells a story about having been robbed and asks for a loan to tide him over until he can get money from his father, to whom he has cabled. There are any number of concerns in the country which have been victimized by this plausible swindler.

LONG DISTANCE WIRELESS.—A despatch from Sydney, N. S., dated Oct. 7, states that while Marconi experts there were testing new receiving cones at the top of the tower at Morien station an operator in the room below picked up the wireless station at Manila in the South Pacific. A message was received saying that the American cruiser *Philadelphia* had arrived at that point all safe. The Marconi people account for the strange happening on the theory that the cone at Morien must have been in perfect tune with that at Manila. The authorities at Washington state that the old cruiser *Philadelphia* is at the Bremerton Navy Yard, near Seattle, and has been out of commission for several years. They scout the theory that a message could be sent from Manila or Bremerton to Sydney. Mr. John Bottomley, secretary of the Marconi Wireless Telegraph Company of America, said that he didn't put any faith in the story. In the first place, he never heard of a Marconi wireless station at Morien. The Marconi station in Nova Scotia is at Cape Breton, some distance away. He also said that there is no Marconi wireless plant at Manila.

WIRELESS TELEPHONY.—A Norfolk, Va., despatch states that wireless telephone communication was had on Oct. 5 by Mr. De Forest between the battleship *Virginia*, at the Norfolk Navy Yard, and the office in Norfolk, a distance of two miles. According to advices from Boston, the battleship *Connecticut* has also been equipped with wireless telephone apparatus, and that in recent tests it was demonstrated that ships equipped with the wireless telegraph, but not with the wireless telephone, could distinctly hear through ordinary telephone receivers what was said in the transmitter of the telephone aboard another ship. Mr. De Forest, on the *Connecticut*, talked into the transmitter of the wireless telephone, and the operators on the *Kentucky* and *Illinois*, although those ships were not equipped with wireless telephones, attached telephone receivers to the wireless telegraph instrument and heard distinctly conversational tones of Mr. De Forest. The *Kentucky* and *Illinois* were 11 miles away from the *Connecticut*. It is stated that in one test spoken words were received on a battleship 22 miles distant from the *Connecticut*.

TELEPHONY IN ALBERTA.—The provincial government's telephone lines have been completed in several parts of Alberta, and work is proceeding briskly on the unfinished sections. The Calgary-Hudson's Bay line is now complete and instruments will be installed very shortly. The line from McLeod to Blairmore and Franklin is practically complete, and will be in operation very shortly, and the same applies to the line from Wetaskiwin to Hardisty and the one from Lacombe to Stettler. The section from Edmonton to Lloydminster is completed as far as Vegreville, and will be in opration before the snow flies. Instruments have been distributed northward from Edmonton for about 30 miles along the line to Athabasca Landing, and the rest of the apparatus will be distributed and the wires strung on the government telegraph lines this fall. If it is not completed, the system will be in such shape that it will be finished early in the spring. When completed this line will have the distinction of being the most northerly telephone line in the world, except the system in operation at Dawson City. When the Alberta government promised to have 500 miles of government line in operation before the end of 1907 there were a number of scoffers, but from the progress made by the various gangs, it is evident that some 600 miles will be in use this year.

VISITORS TO THE SHOW.—The success of the Electrical Show at Madison Square Garden with the public is well known, but it is not realized that a great many central station men have also been attracted. Mr. M. S. Seelman, of the Brooklyn Edison Company, sends us this as a very imperfect list of the visitors to their "seven-room flat in heaven" last week: C. L. Edgar, president, Edison Electric Illuminating Company, of Boston; I. E. Moultrop, superintendent, construction bureau; La Rue Vredenburgh, superintendent, exhibition department; L. D. Gibbs, special agent; T. R. Beal, secretary Poughkeepsie Light, Heat & Power Company; E. O. Richards, superintendent, Newburgh Light, Heat & Power Company; P. T. Glidden, vice-president, Binghamton Light, Heat & Power Company; Jos. B. McCall, president, Philadelphia Electric Company; Alexander Dow, president, Association of Edison Illumination Companies; L. A. Ferguson, vice-president, Chicago Edison Company; F. M. Tait, general manager, Dayton Lighting Company, Dayton, Ohio; C. R. Huntley, vice-president, Buffalo General Electric Company; W. C. L. Eglin, chief electrical engineer, Philadelphia Electric Company; Henry L. Doherty, president, Denver Gas & Electric Company; W. W. Cole, manager, Binghamton Company; Homer E. Niesz, assistant to vice-president, Chicago Edison Company; Walton Clark, vice-president, Public Service Corporation of New Jersey; J. H. Whittlesey, chief engineer; Dudley Farrand, general manager, Percy Ingalls, treasurer, Gen. G. H. Harries, vice-president, E. S. Marlow, treasurer, Public Service Corporation of New Jersey; L. E. St. Clair, general superintendent, Washington Railroad & Electric Company; Gen. F. E. Greene, vice-president, Ontario Power Company; E. L. Davenport, general agent, Narragansett Electric Lighting Company, Providence, R. I.; A. B. Tenney, general manager, H. T. Sands, manager, Haverhill Electric Company; C. G. M. Thomas, vice-president, New York & Queens Electric Light & Power Company; H. E. McGowan, general manager, Flatbush Gas & Electric Company; Geo. Bullock, president, E. E. Witherbee, manager, United Gas Improvement Company, Philadelphia, Pa.; Jos. D. Israel, secretary and manager, P. H. Bartlett, B. J. Lochart, H. M. Haffligh, special agents, Edison Electric Light Company, Philadelphia, Pa.

COLUMBIA UNIVERSITY.—The first meeting of the Electrical Engineering Society of Columbia University, New York City, will be held on Oct. 18, at 8.15 p. m., in room 301, Engineering Building. Professor F. R. Hutton will deliver a lecture on "Gas Engine Units." All who are interested in this subject are invited to attend.

TITANIUM COMPOSITE ARC ELECTRODE.—A patent issued Oct. 1, to Mr. William S. Weedon, of Schenectady, N. Y., describes a luminous arc-light electrode for use with a positive copper electrode, in which titanium sub-oxide is the luminous element. Seven parts of titanium oxide are mixed with one part of carbon and exposed to a temperature of 1500 deg. to 2000 deg. before or after the electrode is formed, thus converting the oxide to a sub-oxide.

MODERNIZING OXFORD it said to be the worthy ambition of Lord Curzon, its chancellor, who as a preliminary step is raising a fund of $1,250,000. He regards an electrical laboratory as a primary need. It will be remembered that Prof. Bell was made a doctor of science at the last commencement, and it is also understood that Mr. Edison was invited to receive a similar honor, but found it impossible to go over to England at the time.

DAY SERVICE AND HEATING DEVICES.—The Boone Electric Company, of Boone, Ia., started a daylight service Oct. 1. Boone is a town of about 9000 population, so that there should be plenty of day load in the course of a year or two. Among other things, a special effort will be made to sell electric heating and cooking appliances. These will be distributed through Mr. H. L. Tillson, an electrical contractor who makes his headquarters at the company's offices.

VICTORIA FALLS POWER.—A special cable dispatch from London, of Oct. 5, says: "Ralph D. Mershon, of New York, one of the consulting engineers of the Victoria Falls Power Company, has just returned to England from South Africa, where he studied the long-discussed problem of transmitting electric energy generated by the Victoria Falls to the mines operated in the Rand. Mr. Mershon boldly declares that there is not the slightest doubt in his mind that the transmission could be profitably effected." It is said, however, that scepticism is entertained in London on the subject.

AERIAL ASSOCIATION.—An announcement has been made of the organization of the Aerial Experimenting Association, with a membership including Prof. Alexander Graham Bell. The association was organized recently at Halifax, Nova Scotia, at a dinner given by Professor Bell to Captain Baldwin, who made a successful airship flight there. The new association will be incorporated in the United States and will carry on the aerial experiments which Prof. Bell has been conducting at Beinn Breagh, N. S. Headquarters will be established at Washington, for the winter, and in the summer will be transferred to Baddeck, C. B.

SWISS TUNNEL ROADS.—The introduction of electric traction on railroads that have long tunnels appears to have had an extraordinary effect in the development of short and long tunnel schemes in Switzerland. Some of the plans for inter-canton and international routes are very ambitious, involving sums as large as $55,000,000 in individual instances. Including local trolley enterprises, there are already in Switzerland 111 projects for which concessions have been granted. It is obvious that the execution of even a small number of these projects would not only require a very large sum of money, but would call for large quantities of hydraulic and electrical apparatus.

WIRELESS REVENUE.—A special cable dispatch from London, of Oct. 5, says: "Intimations more or less authoritative that Signor Marconi has succeeded in establishing wireless service across the Atlantic are followed by forecasts that the public will prefer this method of communication, because it is new, and that the cable companies will suffer. *The Economist* has a carefully reasoned article to-day showing that the wireless system, even if successfully operated, cannot handle more than 3,000,000 paying words annually, and that it will only be equivalent at the most to the laying of the thirteenth cable across the Atlantic with the kingdom as a base, or the seventeenth between Europe and America. The position of the cable companies consequently is not insecure, even if Signor Marconi's expectations are carried out."

RAILROAD TELEGRAPHERS.—By the requirements of the new eight-hour law for railroad telegraphers, which went into effect recently, the number of operators employed by the roads in New York and nine other states should be increased by one-third. Hundreds of station agents, who have been acting as both ticket agent and telegraph operator, will also come under this law, making it necessary to employ two men. The New York Central will not at once comply with the law, being unable to secure 1000 new operators. The New Haven has men enough. The strikers claim that the new law means employment for 8000 more men. The New York Central Railroad, like the Pennsylvania, has established its own telegraph schools at various points to train men for the work. There will doubtless be a larger resort to the telephone.

NATIONAL WASTE.—According to advices from Washington, as the result of an extensive investigation of the country's natural resources, conducted in the West, at the instance of the Government, Prof. J. A. Holmes, Chief of the Technologic Bureau of the Geological Survey, who has just returned, has made an official statement warning the American people that the present prodigious waste of these resources must stop at once if the country is to continue to prosper. Prof. Holmes made the investigation to determine how serious the situation is. He declares that in the mining operations of the present time nearly one-half of the total coal supply is being left underground; that water as a source of power is being wasted day after day and year after year to the extent of millions of horsepower, and that forest fires have burned more lumber than has been used in the building of homes or in the industries. Prof. Holmes says that the waste of coal is appalling. Every possible means should be adopted, he declares, for reducing this waste to an absolute minimum, in order that the country's fuel resources may suffice for the future, as for the present needs of the Nation. At present rates of waste and consumption, he sees an end of the coal supply by the year 2000. And yet the attempt to utilize Niagara is treated as a crime!

TITANIUM is the subject of a report by Mr. F. L. Hess, for the U. S. Geological Survey. Although generally spoken of as one of the rare elements, it is really one of the more common ones. According to Dr. F. W. Clarke, chemist of the Survey, it forms 0.43 per cent of the surface rocks of the globe and is much more plentiful than lead, zinc, copper and other metals classed as "common." A great many schists and gneisses carry titanium, and it is found in appreciable quantities in clays—not only surface clays but also those that have been dredged from the sea bottom. After noting the use of titanium in steels the report says: "Several firms are now experimenting with titanium filaments in incandescent electric lamps, but the reduction of titanium to a metal is so difficult that the lamps have not yet been extensively placed on the market. Titaniferous magnetite and titanium carbide, the titanium of which is derived from rutile, are used as electrodes in arc lamps. When one electrode is made of these substances a block of carbon is used for the other. The best known rutile deposit in this country, the one which produced the greater part of the titanium output in 1906, is at Roseland, Nelson County, Va. A few pounds were produced in Chester County, Pa., where the product is said to occur in comparatively large crystals and to be very pure."

WIRELESS TELEGRAPH PATENTS.—The number of United States patents issued relating to wireless telegraphy (class 178, sub-class 319), up to and including the issue of June 25, 1907, is no less than 463. A complete set of the printed specifications of these patents may be obtained for $13.89 from the Patent Office.

EIGHT-HOUR LAWS.—The Circuit Court of Cass County, Missouri, has held that the new eight-hour statute is unconstitutional and savors of class legislation. This decision follows the attempt of a telegraph operator in the employ of the Missouri Pacific Railway to have the company indicted for compelling him to work more than the prescribed eight hours.

ENCLOSED FUSE FILLING.—A patent issued to Mr. Frederick H. Weston, of Schenectady, N. Y., describes a filler for enclosed fuses consisting of granules formed of slaked lime by the use of a binder. Such granules are stated to be hard, infusible and porous, incapable of being rendered conductive by heat and providing proper interstices for the distribution of the fusing gases for absorption.

CANADIAN TELEGRAPHS.—Owing to the great advance in wages and material the Canadian Pacific Railway Company is increasing telegraph rates by from 100 to 200 per cent. The preparation of a suit before the railway commission has been commenced by newspaper publishers from the head of the lakes to the Pacific coast. The case will be carried before parliament at the coming session. Litigation, based on charges of restraint of trade, is also threatened.

TELEPHONE INDICTMENTS.—At Dallas, Tex., on Oct. 5, Judge Scott, of the Fifty-Fourth District Court at Waco, set the cases against Vice-President and General Manager J. E. Farnsworth and Superintendent C. A. Gales of the Southwestern Telephone Company for Nov. 25. President H. J. Pettingill is also indicted. All are charged with unlawful discrimination in the telephone rates in violation of the anti-trust and anti-pass laws of Texas. In case of conviction the lowest penalty is $200 fine and six months in the penitentiary and the highest $1,000 fine and two years in the penitentiary.

CLEVELAND ELECTRIC CLUB.—On Oct. 2, Mr. C. C. Badeau read a paper before the Electric Club of Cleveland on "Circuit Breakers and Their Relation to Electric Machinery." At the next meeting on Nov. 6 it is proposed to discuss Nernst lamps. The officers for the year ending September, 1908, are: President, Mr. E. E. Ranney, superintendent exchanges, the Cleveland Telephone Company; first vice-president, Mr. George B. Dusinberre, consulting engineer; second vice-president, Mr. C. G. Beckwith, superintendent, Collinwood Municipal Light Plant; secretary, Mr. George L. Crosby; treasurer, Mr. D. M. Hosford; board of managers, Prof. H. B. Dates, electrical engineering department, Case School of Applied Science; Mr. C. E. F. Ahlm, consulting engineer.

TELEGRAPH MONOPOLY.—As the result of application made by Attorney-General Jackson of New York, the Hearst-Socialistic candidate elected at the last election, Justice Ford, of the New York Supreme Court, has issued an order directing the Western Union and Postal Telegraph Cable Companies to show cause before Justice Seabury, this week, why the attorney-general should not get leave to begin an action to vacate their charters and annul their corporate existence. The ground for Mr. Jackson's petition was that the companies had violated the statutes of the State prohibiting monopolies and unlawful restraint of trade and competition. Mr. Jackson charged that a combination was made on Jan. 1, of this year, and that a new and increased schedule of rates was put into effect. The companies, he contended, had agreed to maintain joint offices and divide the profits of business received therein. He alleged, for example, that the companies had agreed to divide hotel business on a basis contrary to the Penal Code of the State.

ORGANIZED LABOR.—Cardinal Gibbons has a forceful article in *Putnam's Monthly* on organized labor, in which he insists that unions have sacred obligations and must be warned against serious dangers. He objects strongly to the boycott, and says that "experience has shown that strikes are a drastic, and, at best, a very questionable remedy for the redress of grievances." As to the "open shop" and intimidation, he says: "Every American citizen has the right to be protected in his efforts to earn an honest livelihood. No man or combination of men should have the power to prevent him from following his vocation, even by intimidation, for he may have not only himself but a wife and children for whom to provide. It is my opinion that the honest laborer who is willing to do work which is proper and in no way conflicts with the interests of the community should be given the opportunity to perform it, and to have the same protection from the authorities which is extended to any peaceful citizen, no matter how powerful or influential may be the person or society which opposes him."

TELEGRAPH CONTRACTS.—The telegraph war between the Pennsylvania Railroad and the Western Union Telegraph Company, begun under the Cassatt régime because of the efforts of the Wabash Railroad to reach the Atlantic seaboard, has ceased, and 25-year contracts have been made. The fight between the Goulds and the Pennsylvania over the former's efforts to reach the seaboard and to gain an entrance into Pittsburg was marked by protracted litigation as well as by numerous physical efforts on the part of the Pennsylvania to oust the Western Union from the Pennsylvania's right of way. The telegraph company's poles were cut down repeatedly, and for a long time there was open warfare between the two interests. The Goulds lost the telegraph business on the lines east of Pittsburg, but after much struggling they gained a railroad entrance into Pittsburg. Their line to the Atlantic seaboard is not yet completed, but unfavorable money market conditions rather than objections on the part of other railroad interests have been held responsible for the work being delayed. The Postal Company made a contract with the Pennsylvania, but it is understood that the renewed Western Union contract will not deprive the Postal of any office of importance.

CANADIAN POWER.—A recent conference was held at Toronto in the Parliament Buildings on the subject of the acquisition of a supply of electric power for distribution by the Hydro-Electric Power Commission. The parties to the consultation were Mr. H. H. McCrae, of the Electrical Development Company, of Ontario; Mr. Geo. Tate Blackstock, K. C., special counsel for that company; Hon. Mr. Whitney, prime minister of Ontario; W. K. McNaught, M. P. P., of the Hydro-Electric Power Commission, and Mr. A. F. Lobb, counsel for the commission. Although no official statement as to the discussion was given out, it is understood that the Electrical Development Company is now desirous to share in the business of supplying the Hydro-Electric Commission with electric energy. The Ontario Power Company has agreed to sell energy to the provincial commission at the rate of $10.40 per horse-power per annum, for 25,000 hp or less, or $10 per hp-year for more than that quantity. It is understood that when the problem was first broached the Electrical Development Company was not willing to meet these rates. Now it is said that the concern wishes to secure equal rights with the Ontario Company, and has submitted a proposition to the Government. This is said to include a provision that it shall serve a certain prescribed area of the province. The Electrical Development Company is allied with the Toronto & Niagara Power Company, which has transmission lines from Niagara Falls to Toronto and to Brantford. By means of these, power could be furnished to municipalities on these routes.

Hydro-Electric Power and Transmission Plant at West Buxton, Maine.

THE supply of electricity for municipal and private use in Portland, Maine, has recently been largely increased and improved by the operation of the new station of the Portland Electric Company. This is a hydro-electric development on the Saco River at West Buxton, about 20 miles from the city, and will amount to 4000 horse-power, produced by four units, of which three are now installed. The electrical energy is transmitted at a potential of 22,000 volts, to the main transformer station in the suburbs of Portland. The development has been carried out by J. G. White & Company, and several interesting features have been introduced in both the design and construction.

While of moderate size the plant at West Buxton represents the best and latest practice in water-power development and utilizes the energy of the river at the point of location practically to its full extent. The accompanying illustrations convey an excellent idea of principal points of the design. In the construction the most notable feature, considering climatic conditions and the handicap of exceptionally rigorous winter weather, has been the rapid rate of work. Construction was begun on Aug. 3, 1906, and the plant was complete and ready for operation Aug. 12, 1907.

A review of the electric light and power situation at Portland is interesting in connection with the new installation. The development of the city in recent years has been steady and substantial, and the population has grown at the rate of about 40 per cent per decade. Portland is now one of the most important manufacturing centers of New England, having about 250 well-established manufactories. The total capitalization of these is $7,000,000, and nearly 5000 operatives are employed. Portland is, besides, the winter terminal of the Grand Trunk Railroad, the general business activity of the city and the demand for electricity being materially augmented by this fact. The large demand for power, coupled with the high cost of coal, has stimulated water-power development and made necessary the installation at West Buxton.

At the present time there are two principal companies doing the electric lighting and power business of Portland, namely, the Portland Lighting & Power Company, and the Consolidated Electric Light Company of Maine. The Portland Lighting & Power Company is supplied with electricity generated by a hydro-electric plant of 2500 hp, located at Great Falls on the Presumpscot River, 20 miles from Portland. This company has the city lighting contract and also furnishes electricity for commercial purposes, particularly in the suburban territory. The Consolidated Electric Light Company operates a modern and efficient steam plant of about 2800 horse-power in Portland, and supplies most of the general commercial demand of the city, where its distribution system is extensive. A considerable portion of the distribution system is underground. Both of these companies have been running their plants at full capacity for some time.

The West Buxton development, with the transmission lines and the sub-station in Portland, is owned by the Portland Electric Company, and the Consolidated Electric Light Company has contracted for the entire output. It will thereby be enabled to take care of the great influx of new lighting and power contracts signed and in prospect. By the combined operation of the three plants described, Portland is placed in a unique position. Its residents now pay lower rates for electricity than is charged in any other city in New England.

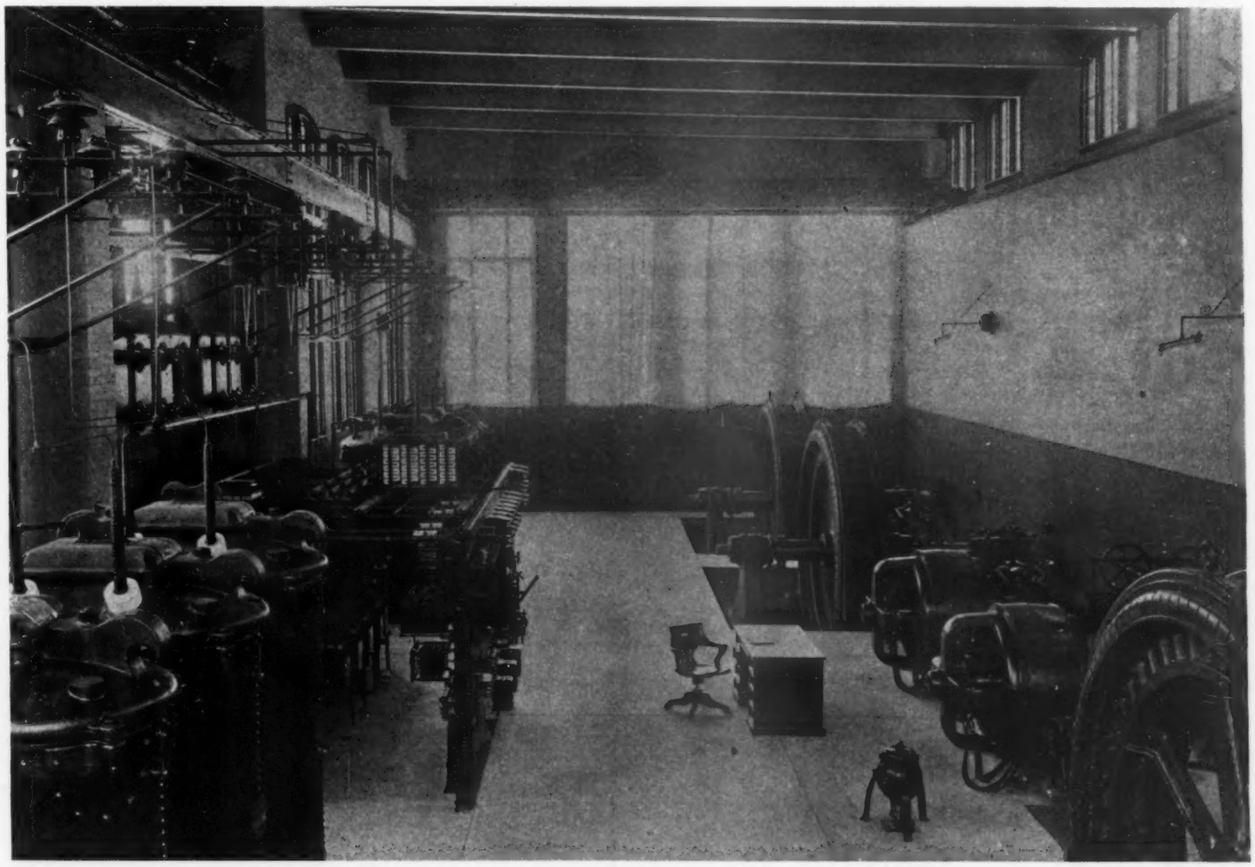


FIG. 1.—INTERIOR VIEW OF THE WEST BUXTON POWER HOUSE OF THE PORTLAND ELECTRIC COMPANY.

The design of the West Buxton plant, and in particular the transmission system, is based on the purpose of ultimately uniting the service with that of the Great Falls water-power plant at a main transformer station in Portland. The transmission lines from the Great Falls plant are to be carried direct to the new station. This will permit the abandonment of several sub-stations and auxiliary plants. The high-tension current from both West Buxton and Great Falls will be reduced to

a uniform pressure of 2300 volts for transmission to the Consolidated Electric Light Company's plant. There, motor-generator sets are placed for converting the united output to direct current at 250 volts, which is distributed by a three-wire system throughout the business section of the city. At present there are installed at the main transformer station mentioned, six 500-kw, 22,000/2300-volt self-cooled units, with provision for

FIG. 2.—POWER HOUSE, ONE END OF DAM AND COFFERDAM AT POINT OF FINAL CLOSURE.

further transformer equipment to handle the Great Falls output.

The transmission line from the West Buxton plant to Portland consists of two three-phase circuits of No. 2 wire, a metallic telephone circuit of No. 12 copper wire, and a ground circuit of No. 12 phono-electric wire. The main line insulators are triple petticoated, glazed porcelain, and are mounted on hard maple pins. The circuits are carried one on either side of the pole on two cross-arms and the triangles are inverted. The wires are placed 36 ins. apart. The telephone wires are carried on brackets below the lower arm, while the ground wire is run over the tops of the poles and grounded at every sixth pole through a No. 4 B. & S. copper wire, connected by a brass screw-plug with a galvanized-iron pipe driven 6 ft. in the ground. The cross-arms are of long-leaf yellow pine, and are doubled at points of curvature on the line. The poles are "butt-cut" chestnut and vary from

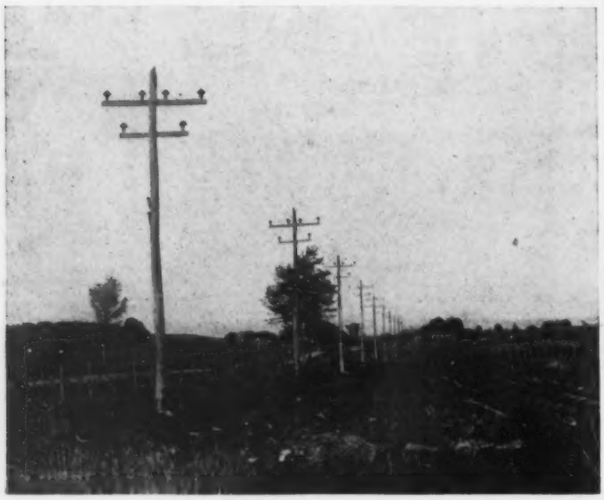


FIG. 3.—MAIN TRANSMISSION LINE FROM WEST BUXTON TO PORTLAND.

35 ft. to 60 ft. in length, having a minimum diameter at the top of 8 ins. The spacing is 100 ft. on tangents.

At West Buxton the principal structures of the plant proper are a concrete dam and a power house, which is built of concrete and brick. The power house is located on the east bank of the river, with the dam abutting against it and the water is taken directly from the storage pond. The dam is 300 ft. long, 30 ft. high and 29 ft. thick at the base. It consists essentially of monolithic sections 40 ft. long, keyed together and also into the rock foundation. The entire plant is founded on bed rock. The intake and head works are protected by a reinforced concrete wing wall and boom 140 ft. long running from the abutment of the dam at an angle of 45 deg. to the shore. The lower edge of the boom is sufficiently beneath the

FIG. 4.—CONCRETE FOUNDATIONS OF POWER HOUSE IN COURSE OF ERECTION DURING WINTER.

surface of the water at all stages of the river so that floating débris will be skimmed off and carried along its face to a chute in the adjacent end of the dam. Six concrete piers support the boom.

The construction, including the placement of the major part of the concrete in both dam and power house, was carried on without interruption throughout last winter, which was exceptionally cold. The cement was mixed with hot water and the rock and sand were thoroughly heated before mixing. Special appliances were devised to carry out the heating process

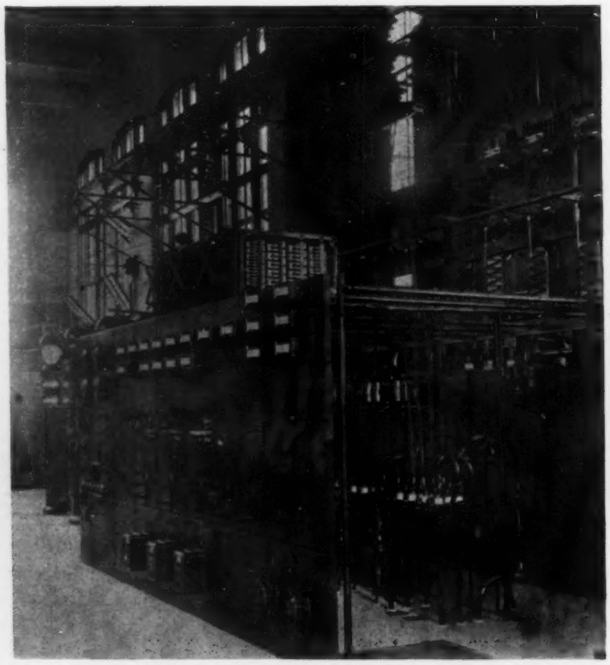


FIG. 5.—SWITCHBOARD IN WEST BUXTON STATION.

rapidly and economically. Though much of the concrete was placed in a surrounding temperature of 30 deg. below zero, and nearly all of it under freezing conditions, none was injured by freezing and the finished work has proved exceptionally free from defects. The work was safeguarded probably by the expedition with which the mixed material was placed after heating and by the heat stored in the solid con-

stituents which was sufficient to allow the mass to set before it was reduced to a freezing temperature.

The control of the river during construction involved some special problems. Use was made in part of an old timber mill dam conveniently located just above the new dam site. The old dam was raised for a part of its length and an area including the situation of the new power house and about 200 ft. of the new dam was surrounded by a cofferdam built down stream from the old dam and then in to the east bank of the river. During the construction of these coffers the west abutment and the end section of the dam were being built. When the cofferdam was completed the original timber dam was opened west of the point where it was joined to the cofferdam and the entire flow of the river was sent through that channel. Then the power-house foundations and the adjacent 200-ft. section of the dam were built in the area reclaimed from the river.

The next step was to block the channel, cut through the old dam, thereby directing the flow of the river through the power house and exposing the foundations for the final dam section. The aperture in the old dam was first narrowed as much as possible by constructing cofferdams from each side toward the center. The projecting ends were finished square and parallel, and were provided with shoulders running from top to bottom. Across the narrow remaining opening, heavy joists were laid and upon these joists a massive timber gate was built in position to be dropped into the opening. The supporting joists were then sawed through to the safe limit and dynamite charges were inserted at each sawed section. All the charges were connected on the same circuit. They were then simultaneously exploded; the supporting timbers parted and the gate fell solidly into place, resting against the shoulders of the cofferdam. The river then flowed through the power-house draft tubes and over the completed section of the dam, permitting the last section to be built very easily.

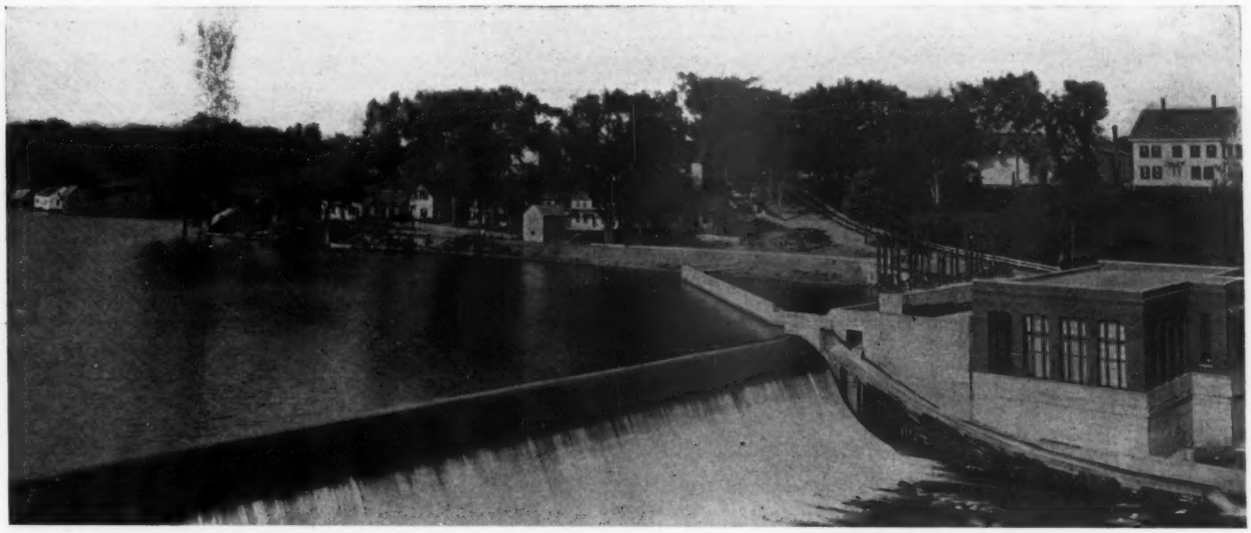


FIG. 6.—DAM AND POWER HOUSE OF THE PORTLAND ELECTRIC COMPANY ON THE SACO RIVER AT WEST BUXTON, MAINE.

The arrangement of the machinery in the West Buxton plant is unusually logical and conduces to simplicity of operation. The main and exciter turbines are of the horizontal immersed type and each unit is placed in a separate wheel chamber, with the shaft projecting through the chamber wall into the generating room where the electrical unit is coupled on. Each of the four main generators is rated at 750 kilowatts, and generates three-phase current at a potential of 2300 volts. The

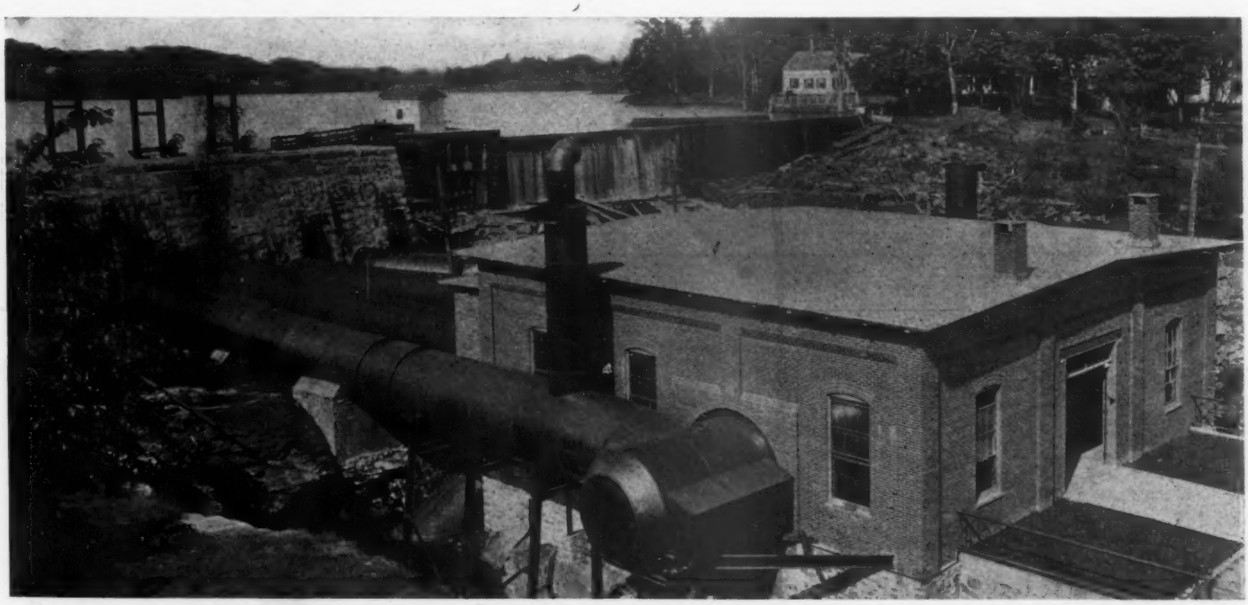


FIG. 7.—GREAT FALLS PLANT OF THE PORTLAND LIGHTING & POWER COMPANY ON THE PRESUMPSCOT RIVER.

speed is 150 r. p. m. There are two 125-volt, 75-kw exciter units running at 360 r. p. m.

Each of the main turbines is made up of two wheels, having a diameter of 48 ins. and each is designed to develop 1340 horse-power under a 25-ft. head. The wheel chambers in which the turbines are placed are 12 ft. deep and the draft tubes are 13 ft. long. Water is admitted at the ends of the turbine, and the gates are regulated by means of a Lombard-Replogle governor, belt-

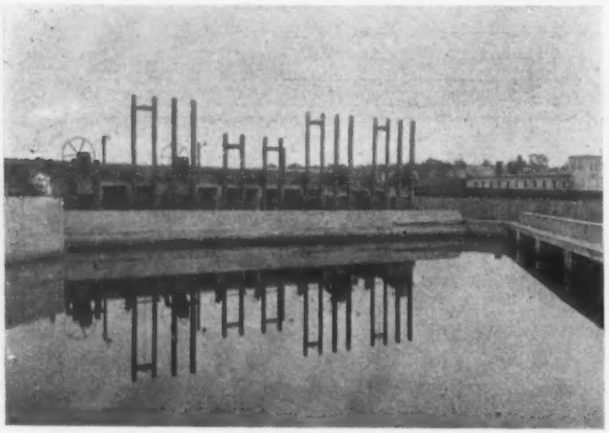


FIG. 8.—BOOM, INTAKE AND HEADGATES AT WEST BUXTON.

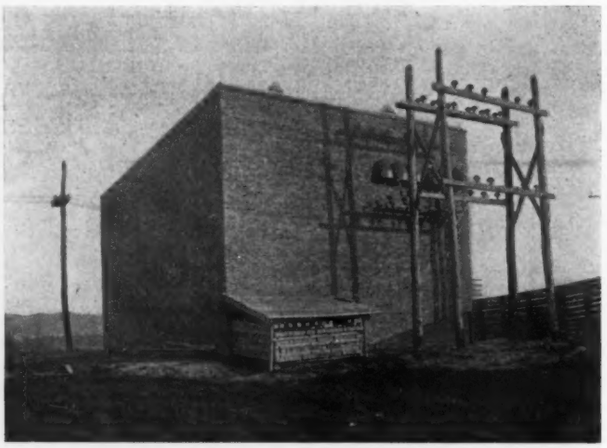


FIG. 10.—MAIN TRANSFORMER HOUSE IN SUBURBS OF PORTLAND.

driven from the main shaft. The gate shaft is parallel with the main shaft and controls the gates by means of reach rods. The gates are 48 ins. in diameter and 22 ins. wide. The common discharge from the two wheels of each machine is into a heavy cast-iron box at the center. Below the draft boxes are the draft tubes, which are conical, 10 ft. in diameter at the upper end and 12 ft. at the lower and 13 ft. long as above noted. These tubes are designed to give a velocity of 5 ft. per second at the lower end with eight-tenths water. They discharge into concrete channels which run beneath the generating room to the tail-race.

The over-all length of the main generating units is 41 ft., and each has six shaft bearings, two at the generator and three in the turbine, with an intermediate thrust bearing. The turbine bearings are located one at each end and one at the center in a yoke bolted to the draft box, and are of lignum-vitæ. The thrust bearing is three feet long and is provided with four collars. The shaft is 9 ins. in diameter at the bearings.

The flow to the wheel chamber of each of the main generating sets is controlled by three independently operated head gates. There are two main gates and a filler gate for each wheel, all constructed of yellow pine. The main gates are 7 ft. 9 ins. wide and 13 ft. high, and they differ from each other only in controlling mechanism. One may be manipulated under full head and the other only under a comparatively small head when the wheel chamber is nearly full. However, to facilitate the movement of the main gate in starting up a set, a filler gate is provided to be used ordinarily for filling the wheel chamber. All the gates are operated by hand mechanism of the standard worm gear, pinion and rack design, allowing a lift of 13 ft. The exciter turbines have a rating of 100 horse-power, and are of

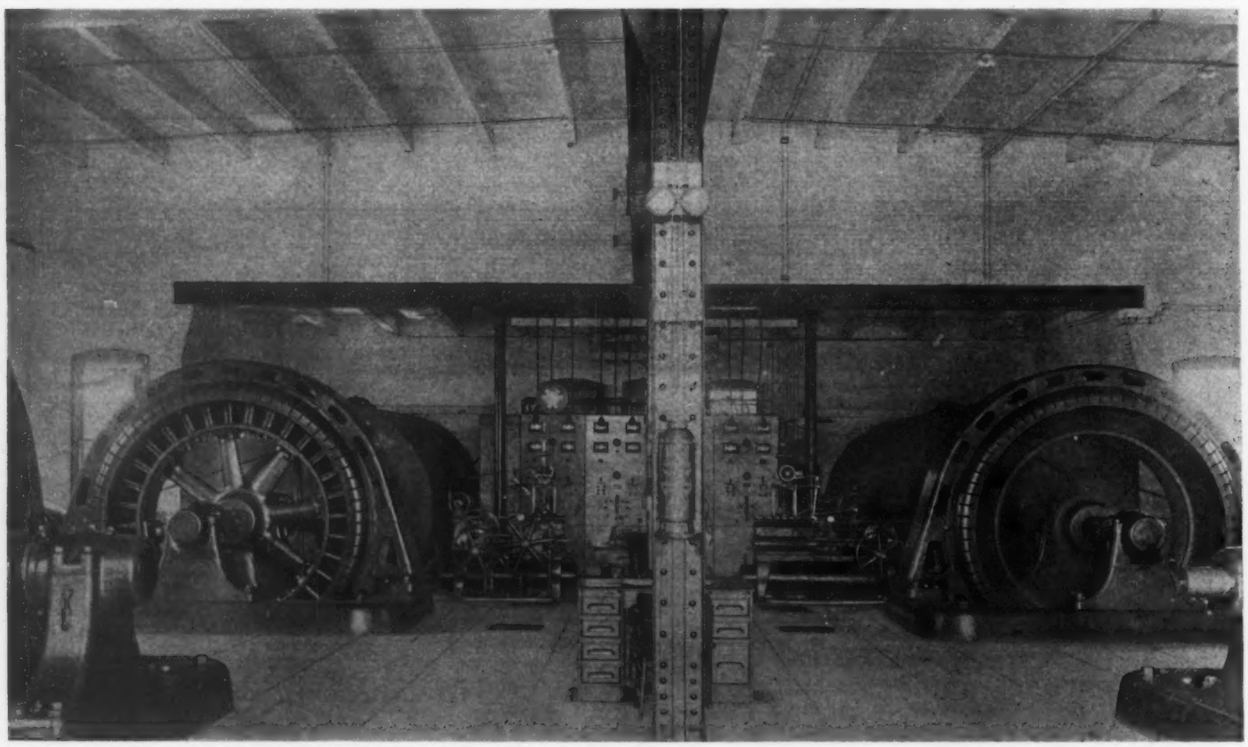


FIG. 9.—INTERIOR OF THE GREAT FALLS PLANT OF THE PORTLAND LIGHTING & POWER COMPANY.

single wicket gate design, 21 ins. in diameter. They are controlled by individual head gates.

The main generators are of the revolving-field type and are designed to carry an overload of 25 per cent for two hours without excessive overheating. They have a full load efficiency of 94 per cent and an efficiency of 91 per cent at half load.

The switchboard and transformers in two banks of three each, are arranged in a row opposite the generating machinery. The transformers are rated at 500 kilowatts, and are oil-insulated and water-cooled. The cooling water is circulated through a coil in the upper part of the transformer tank over the core and surrounding the ends of the windings. The water is taken from the forebay, near the exciter turbines, and carried beneath the floor in two 3-in. pipes, which are connected by a third 3-in. pipe running crosswise under the transformers. This cross pipe is connected with another lateral pipe lying close to the transformers, by risers in which are placed suitable screens. One-inch pipes lead directly to the respective transformers from the secondary lateral pipe. A glass is provided in the water circuit of each transformer so that the circulation is always under observation. From the transformers the discharge pipes lead downward into the tail-race.

The switchboard and apparatus is designed for a current capacity commensurate with the 22,000-volt transmission pressure, and automatically operated oil switches are used on the outgoing lines. There are nine principal panels as follows: One exciter panel, one regulator panel, four three-phase generator panels, one transformer panel and two outgoing line panels.

The entire electrical equipment of the West Buxton plant has been provided by the General Electric Company. All the turbines are of the S. Morgan Smith manufacture, as well as the hoists of the main head gates. The Dayton Globe Iron Works provided the hoists for the smaller gates. The construction of the plant and transmission system has been very

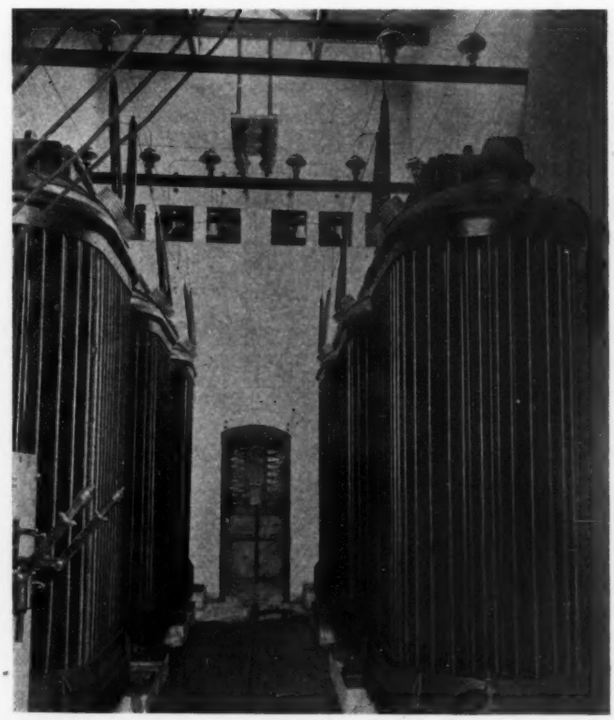


FIG. II.—INTERIOR VIEW OF MAIN TRANSFORMER HOUSE OUTSIDE PORTLAND.

materially simplified and expedited through the fact that J. G. White & Company, besides being contractors for the installation, are also the operating managers of all three of the public service properties in Portland, effected by the development. Naturally, decisions as to plans for co-ordinating the new construction with the plants already in use have been reached with little or no unnecessary delay.

Unbalanced Loads in Two-Phase to Three-Phase Transformation.

BERNH. F. JAKOBSEN.

In the two-phase to three-phase transformer arrangement of Fig. 1 there are two independent magnetic circuits, and on the two-phase or secondary side two coils with N_1 turns each. Taking the ratio as 1 to 1 the coil $A\,A'$ has also N_1 turns, the coil $B\,C$ has $N_2 = \frac{2}{\sqrt{3}} N_1$ turns. It is well known that when the load on the two-phase side is balanced, the load on the three-phase side is balanced also. The present article deals

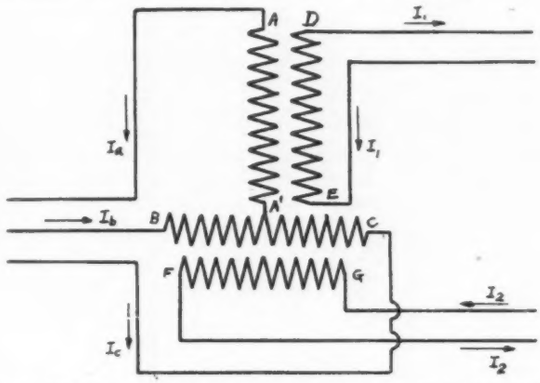


FIG. 1.—CIRCUIT DIAGRAM IN TWO-PHASE TO THREE-PHASE TRANSFORMATION.

with the determination of the effect of different loads taken under different time-phase-angles on the two-phase side.

Let the transformer coils be so interconnected that a current flowing from A' to A results in a current flowing from E to D, and let all currents flowing towards A' be called negative, and let the current produced by a positive current be called negative if it exists in coil $A'\,A$ and $D\,E$, and let a positive current in BA' and a negative current in $A'C$ be considered as producing a negative current in FG, flowing from G to F.

In order to draw up the vector diagram one has only to remember that, neglecting all losses: (1) The ampere turns of corresponding coils must be equal but oppositely directed, or $\Sigma\,(N \times I) = 0$. (2) The algebraic sum of the three-phase currents must be equal to zero, or $\Sigma\,(I) = 0$. (3) The input must equal the output.

It should be noted that if the current I_b and I_c are equal and in time-phase—that is, both flow simultaneously either away from A' or towards A'—the resultant m. m. f. is zero. If they are equal, but opposite in time-phase ($I_b = -I_c$) the m. m. f. in ampere-turns is $N_2 I_b$. In the first case I_b and I_c taken together represent no power; in the last case the power is $P = I_b E_{ab} \cos\phi$.

Fig. 2 shows the diagram for a balanced load. $I_a = I_b = I_c = I_1 = I_2$, and the phase angles are alike. If N_2 is represented as unity $N_1 = \frac{\sqrt{3}}{2}$, and the ampere turns of I_1 are represented to scale by $OK = N_1 I_2 = \frac{\sqrt{3}}{2} I_2$, the ampere turns of I_b is represented to scale by $OM = I_b \times \frac{N_2}{2} = \frac{1}{2} I_b$, etc. The currents I_1 and I_a must always be equal but opposite in time phase. The ampere turns in FG are $N_1 I_2$ and must be equal to those in coil BC. The ampere turns of BC may be represented as $\frac{N_2}{2}(I_b + I_c)\cos 30^\circ = \frac{2}{\sqrt{3}} \frac{N_1}{2} - 2 I_b \tfrac{1}{2} \sqrt{3} = I_b N_1 = I_2 N_1$ as should be.

I. Now let I_1 in Fig. 2 be increased by say 50 per cent, then I_a also increases 50 per cent. I'_a enters coil BC at A' and must go through that coil without changing the resultant m. m. f., which is possible only when the increment current, $\triangle I_a = I_a I'_a$, divides itself into two equal parts, each of which magnetically counteracts the other. The current ΔI_a is added to the current

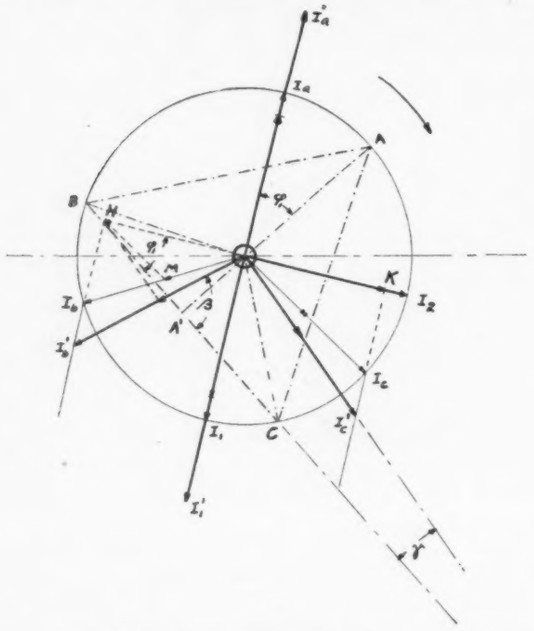


FIG. 2.—VECTOR DIAGRAM OF CURRENT RELATIONS; BALANCED LOAD AND OVERLOAD IN SECONDARY PHASE 1.

I_a and the current $-\frac{1}{2}\Delta I_a$ is added to I_b and I_c. The increment of current in BA' $(-\frac{1}{2}\Delta I_a)$ is equal and in time-phase with that in $A'C$ so that they neutralize each other magnetically. BC represents the line voltage on the three-phase side, and its time-direction is parallel to the voltage in the coil FG. The time-phase angle for I_1, I_2 and I_a is ϕ_1, for I'_b it is β, and for I'_c it is γ. Since $\beta = \gamma + 2\phi_1$, the power in BA' and $A'C$ (Fig. 1) are not equal unless $\phi_1 = 0$.

The power in the coil BC is unchanged as the increments of currents ΔI_b and ΔI_c are in time-phase. The currents corresponding to I'_a (in Fig. 2) are I'_b and I'_c and, therefore,

$$I'_c = I'_b = \sqrt{I^2_b + \tfrac{1}{4}\Delta I_a{}^2 - 2I_b \times \tfrac{1}{2}\Delta I_a \, Cos\, 120^\circ}$$

$$I'_c = I'_b = \sqrt{I^2_b + \tfrac{1}{4}\Delta I_a{}^2 + \tfrac{1}{2} I_b \Delta I_a}$$

II. In Fig. 3 I_1 retains its normal value, but I_2 has been in-

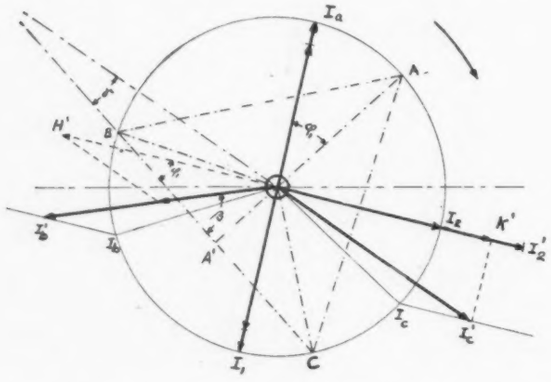


FIG. 3.—VECTOR DIAGRAM OF CURRENT RELATIONS; OVERLOAD IN SECONDARY PHASE 2.

creased by 50 per cent to I'_2. OK' is now the ampere turns of the coil FG and OH', which ampere turns the coil BC must produce. In order not to affect I_a, two currents equal in value, but opposite in time-phase, must be added, one to I_b and the other to I_c, for only then will $I_a + I_b + I_c$ remain zero. The increase of the ampere turns in coil FG is $I_2 I'_2 N_1 = \Delta I_2 N_1$. This must equal the increase in BC, and consequently there must be added to I_b and I_c two equal but opposite currents, $I_b I'_b = \Delta I_b$ and $I_c I'_c = \Delta I_c$, the vector being parallel to I_2. Thus

$$N_1 \Delta I_2 = \tfrac{1}{2} N_2 \, (\Delta I_b + \Delta I_c)$$

$$N_1 \times \Delta I_2 = \tfrac{1}{2} \frac{2}{\sqrt{3}} N_1 \times 2\Delta I_b$$

$$\Delta I_b = \frac{\sqrt{3}}{2} \Delta I_2$$

The resulting currents are then:

$$I'_b = I'_c = \sqrt{I_a{}^2 + \Delta I_b{}^2 - 2 I_a \Delta I_b \, Cos\, 150}$$

$$= \sqrt{I_a{}^2 + \tfrac{3}{4}\Delta I_2{}^2 + \frac{3}{2} I_a \Delta I_2}$$

If ϕ be the time-angle between ΔI_b and the voltage BC, the increase of power in coil BC would be:

$$\Delta P_{bc} = \Delta I_b \, E_{ab} \, Cos\, \phi$$

ϕ is also the time-angle between I_2 and the voltage FG and the increase of power therefore is,

$$\Delta P_{fg} = \Delta I_2 \, E_{fg} \, Cos\, \phi$$

Since $\Delta I_b = \frac{\sqrt{3}}{2} \Delta I_2$ and $E_{ab} = \frac{2}{\sqrt{3}} E_{fg}$, therefore

$$\Delta P_{bc} = \Delta P_{fg}$$

If in case I, $I_a = I_b = I_c = 10$ amp. and $\Delta I_1 = \Delta I_a = 5$, then $I'_a = 15$ and $I'_b = I'_c = 11.47$ amp. and the line loss on the three-phase side is in watts $P_1 = R\ (15^2 + 2 \times 11.47^2) = 487.5\ R$.

If in case II, $I_a = I_1 = 10$, and $\Delta I_2 = 5$, then $I'_2 = 15$ and $I'_b = I'_c = 13.9$ amp. and the line loss is, in watts, $P_2 = R\ (10^2 + 2 \times 13.9^2) = 487.5\ R$.

The power transmitted was the same in the two cases and such was true also of the copper loss of the line.

III. Assume the same conditions as under I with the exception that the time-phase angles in the two-phase circuits are not

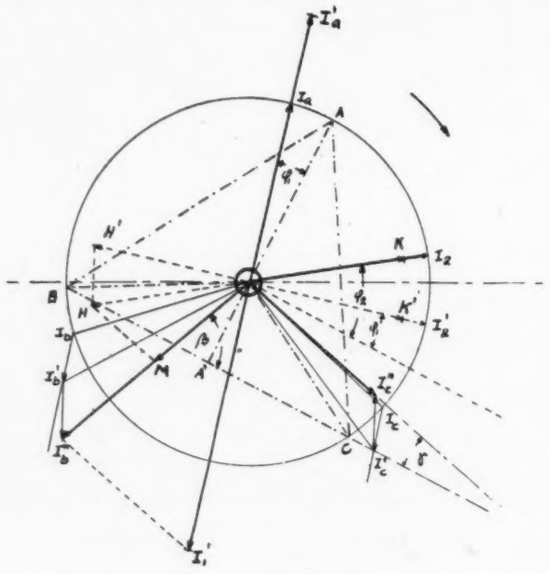


FIG. 4.—VECTOR DIAGRAM OF CURRENT RELATIONS; OVERLOAD IN SECONDARY PHASE 2, THE TWO SECONDARY ANGLES OF LAG BEING UNEQUAL.

alike. Since the voltages in the coils DE and FG are in electrical time quadrature, the currents are not in quadrature. In Fig. 4 I'_1, I_2, ϕ_1 and ϕ_2 are given. The vector-diagram is con-

structed with ϕ_1 as the time-phase angle for each current and the currents I'_b and I'_c are obtained as before in Fig. 2. OK' is then the ampere-turns in the coil FG, and OH' is the ampere-turns in BC. $OK = N_1 I_2$ is, however, the ampere turns in FG with the time-phase angle ϕ_2 and OH is the ampere turns required in BC. The difference between OH' and OH is $H'H$ and these ampere turns must be supplied by I'_b and I'_c. In order not to disturb the equilibrium on the three-phase side, equal but oppositely-directed currents must be added to I'_b and I'_c and in order to compensate for $H'H$ a current $I'_b I''_b = H'H$ must be added to I'_b and a current $I'_c I''_c = -HH'$ must be added to I'_c. The resultant currents I''_b and I''_c are then obtained, where $I''_b > I''_c$.

General Solution: The vector-diagram for any conditions can be constructed in a much easier, though less instructive manner, as shown below. Referring to Fig. 5 where I_1, I_2, ϕ_1 and ϕ_2 are secondary quantities, and assuming that the three-phase voltage has not been distorted, $I_a = -I_1$. $OK = I_2 N_1$ is the value of the ampere-turns produced by I_2 and $OH = -OK$ is the ampere-turns to be produced in the coil BC. Let $HH' = OH$, then OH' equals twice the m. m. f. in coil BC. The problem is

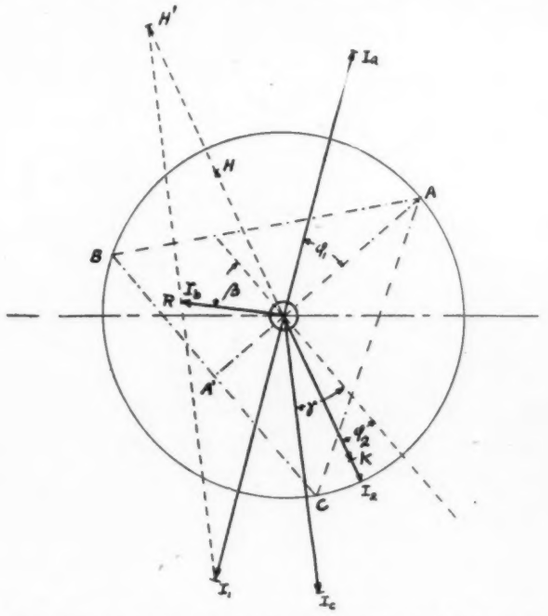


FIG. 5.—VECTOR DIAGRAM OF CURRENT RELATIONS; GENERAL SOLUTION.

then to find the value of the two currents I_b and I_c whose resultants are OH', and, at the same time, OI_1; that is to say, $H'R = RI_1$ and $OR = I_b$, $RI_1 = I_c$. It is seen from the construction of Figs. 4 and 5 that when angle $I_1 O I_2 = 90°$, then $I_b \gtrless I_c$.

The vectors I_b and I_c in all of the diagrams represent the currents in BA' and $A'C$ and also twice the ampere turns in their respective coils. In Fig. 5, ϕ_1 is positive and ϕ_2 negative, β is positive and γ negative.

The vectors OA, OB and OC in Figs. 2, 3 and 4 represent the phase-voltages of a star-connected generator feeding the three-phase side of the transformer.

When $I_1 = O$ then $I_a = O$ (neglecting the magnetizing current) and $I_b = -I_c$, that is, they are 180 deg. out of time-phase with each other and producing m. m. f. opposite in time-phase to that of I_2, so that $I_2 = \frac{2}{\sqrt{3}} I_c$.

When $I_2 = 0$, $I_1 = I_a$ and $I_b = I_c = -\frac{I_a}{2}$ or I_b is in time-phase with I_c and the resultant m. m. f. is zero. They are both 180 deg. out of time-phase with I_a.

Single-Phase Equipment of the Rochester Division of the Erie Railroad.

As has been noted in our columns from time to time, and as discussed in our issue for Jan. 29, 1907, the first American steam railroad to substitute single-phase motors for steam locomotives in the propulsion of its trains was the Erie, on its Rochester Division. We are able to give below a description of the numerous details embodied in the electrical equipment of the above division.

The section of track equipped is 34 miles long, extending from Rochester, over the main line of the Rochester Division, to Avon, a distance of about 19 miles, thence 15 miles over the Mt. Morris Branch. The railroad is entirely single-track, with sidings at way stations, averaging 3 to 4 miles apart. The grades are light, and the curvature for the most part quite easy, the line being relatively quite straight.

The electric service is devoted solely to passenger traffic, which is of the local interurban type. There are in use six motor-cars, each of which is equipped with four conductively-compensated series-connected single-phase motors of Westinghouse manufacture. These motors are operated with 25-cycle current taken from auto-transformers, which receive their supply at 11,000 volts from an overhead catenary trolley wire. Electrically considered, the motors are similar in every respect to those in use on the New York, New Haven & Hartford

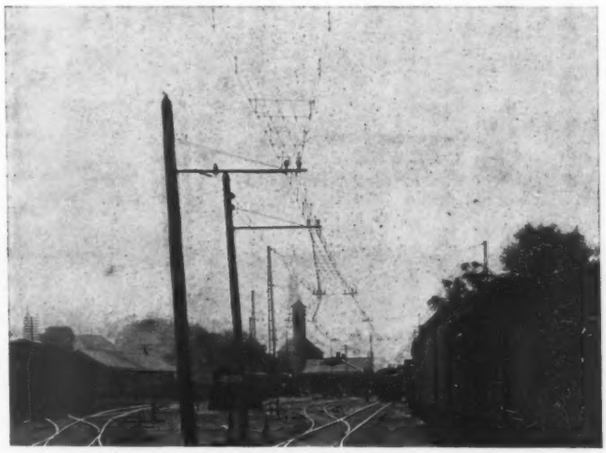


FIG. 1.—CATENARY LINE CONSTRUCTION IN THE AVON YARD.

locomotives, being provided with compensating field coils for neutralizing the armature reactance, and thereby improving the power-factor, and being equipped with "preventive resistance leads" between the commutator segments and the armature winding to minimize sparking at the brushes. The auto-transformer on each car is rated at 200 kilowatts, and is of the oil-insulated, self-cooling type. It has three high-potential and eight low-potential taps, the e. m. f.'s of the latter varying from 300 to 110 volts.

All of the switches connected with the trolley mechanism, the auto-transformer, and the motors themselves are operated by compressed air, the valves for which are controlled electro-magnetically. The car equipment, therefore, includes three distinct electrical circuits, the high-potential 11,000-volt trolley circuit, the low-potential motor circuit, the e. m. f. of which does not exceed 300 volts, and the control circuit, the e. m. f. of which is 15 volts.

The high-tension wiring of the car consists mainly of varnished cambric cable, drawn through loricated iron conduit. A small amount of high-grade rubber cable is used, but it is thoroughly protected with varnished cambric tape wherever there is danger of a brush discharge to ground breaking down the insulation. The high-potential circuit passes from the pantograph trolley through the line switch to the 11,000-volt tap on the auto-transformer. The trolley mechanism is operated by a pair of springs, and by an air cylinder. The trolley is

raised and held against the wire by means of springs, and it is lowered by the application of air pressure to pistons working in cylinders that form part of its base. When down, it is automatically locked, and the latch of this lock can be withdrawn only by applying air pressure to another small piston, which then unlocks the pantograph, allowing the springs to raise it. The trolley mechanism is so connected with the control circuit through the line relay that any interruption in the supply of high-tension current immediately causes the trolley to be lowered by applying the air to the main cylinder in the trolley base.

The line switch is equivalent to a main high-tension circuit breaker. It is opened and closed by air pressure, admitted by electrically operated valves. In case the supply of air is exhausted, as when the car has stood for some time unusued, the line switch must first be held in mechanically by means of a handle provided for the purpose until the air pump, which can then be placed in operation, has compressed air to a pressure of about 50 lbs. per sq. in., which is sufficient to actuate the control system. For the purpose of raising the trolley when there is no air pressure, there is provided a small automobile tire pump placed underneath one of the car seats, which is connected by a three-way cock into the trolley air piping system, and enables the air-operated trolley latch to be withdrawn and power obtained that will start the air compressor and set going the motor generator set, which is used for charging the storage battery and supplying energy to the control circuit.

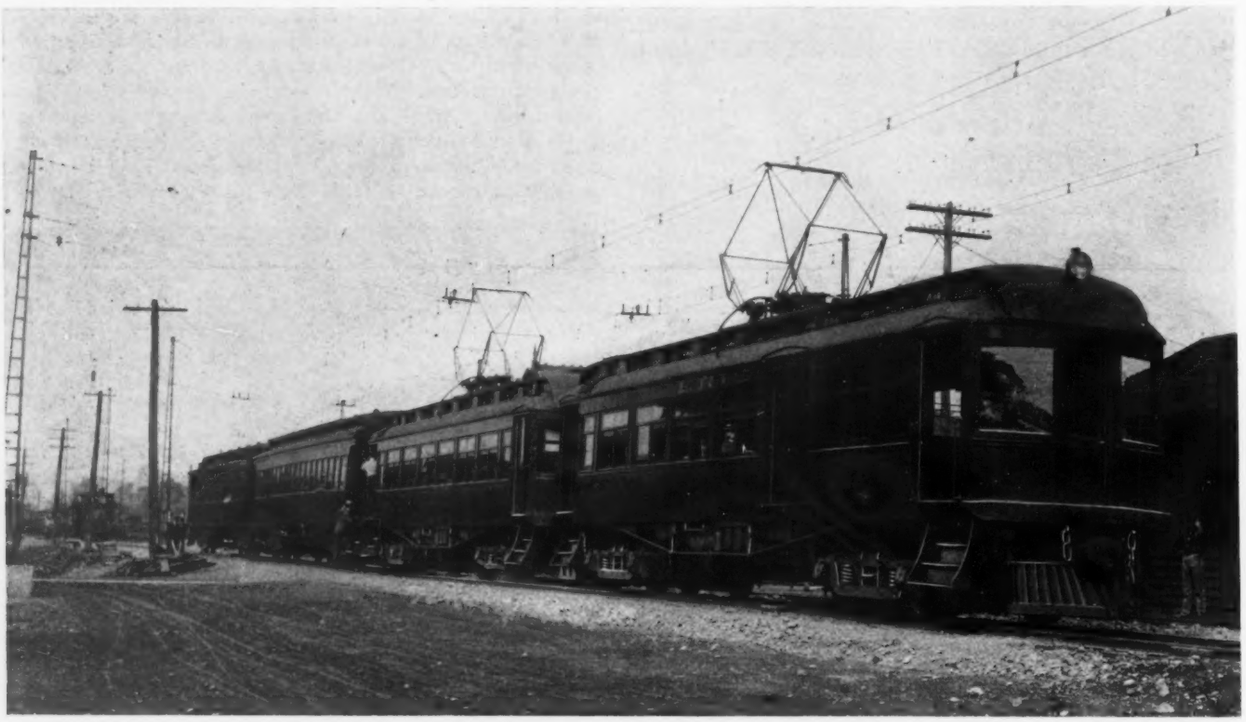


FIG. 2.—ELECTRIC TRAIN AT AVON.

In the main low-potential circuit are the switch-group, the reverser, and the "preventive coils." All of the switches of the group are provided with interlocks, which automatically govern the connections in such a way that each switch of the group acts only when the current in the motors has decreased to a predetermined value, thus making the acceleration automatic. The "preventive coils" are small auxiliary auto-transformers used in connection with the main transformer in order to prevent the short-circuiting of the intervening turns when the motor connections are changed from one tap to another on the main auto-transformer.

The control circuit includes a master controller, in each vestibule, the train line wires and their connections to the valve magnets and interlocks, a storage battery supplying energy for these wires, and a motor generator set, which is used either to charge the batteries or to actuate the control system. The master controller makes the proper connections by means of which energy from the storage battery actuates the valve magnets which control the action of the air-operated main contracters in the switch group, and the reversers. The controller handle is normally held in a vertical central position by springs, unless it is moved to one of the running points by the motorman. When released from the grasp of the hand, it flies to the vertical position, opening the circuit, and enabling the emergency application of the brakes by means of brake relay valve alongside of it. There are two holes in the face of the master controller, directly under the handle, and attached to the handle by means of a chain is a plug which may be inserted into either of these holes. The master controller is not operative unless this plug is pushed all the way into the lower hole, which closes the line switch, connects the generator and battery, and puts the brake relay valve into circuit. This is the ordinary running position of the plug. In case the line switch is opened by an overload, which generally causes the trolley to be lowered, the plug is taken out of the lower hole and placed in the upper, which action immediately closes the line switch, releases the trolley, and allows it to spring up against the wire. As soon as contact is made with the main circuit, the plug is taken out of the upper hole and replaced in the lower one.

There is a push button upon each side of the bottom of the master controller case. That on the right-hand side is used for lowering the trolley and opening the line switch. When the button on the left-hand side is pressed the switch group connection is stepped up to the last or high-speed notch and remains in that position until the handle of the controller has been returned to the off position.

There are four distinct notches on each side of the controller, the first corresponding to the coasting position with the main circuit open, the others enabling such gradations of speed as may be desired. Reversal is effected by moving the controller handle to the opposite side of the center or dead point. If the controller stops on the dead point, as it will if released by the hand, the brakes will be applied immediately.

The motor generator set is a compact machine of about ⅙ kilowatt, the motor being of the self-starting induction type,

wound for 110 volts, the generator delivering normally about 23 volts. It is placed under one of the seats in the car and is covered by a box with removable lid, so that it can easily be reached for such small attention as it requires. It is mounted upon rubber bushings, and runs so quietly that its presence in the car can hardly be detected.

The storage battery consists of seven cells contained in a wooden box with handles, carried in an enclosed box underneath the car. No other auxiliary lines for any purpose are connected to the control circuit, in order to prevent it from being disabled by accidental grounds.

In one vestibule there is located in an asbestos-lined compartment enclosed with steel doors a slate switchboard panel upon which are carried all the switches and fuses for the control of the battery and motor generator set, the lighting circuits and heaters, and also the main connection from the low-tension side of the main autotransformer to the auxiliaries.

The control circuit is fitted with junction boxes, branches running to receptacles at each of the four corners of the car directly under the end sills. The jumpers for connecting the cars and the receptacles are of the 12-point type, there being 12 wires in the main control circuit.

All of the low-tension wiring between the transformer and switch group and motors is enclosed in a boxing of "Transite," to insure its protection against mechanical injury, as the inductive effect of heavy currents renders the use of iron conduits impossible for this part of the wiring.

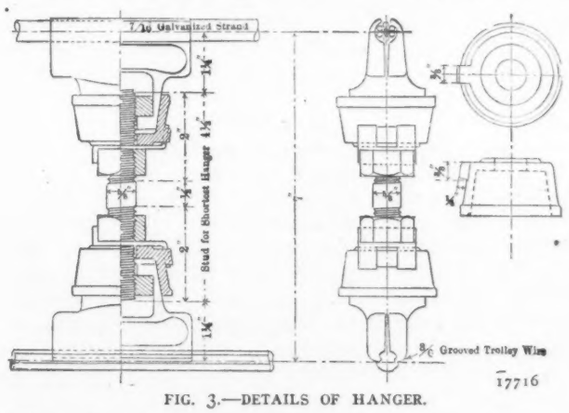


FIG. 3.—DETAILS OF HANGER.

The air brake and electrical equipment were placed upon the cars by the engineers at the Buffalo car shops of the Erie Railroad.

CATENARY TROLLEY CONSTRUCTION.

The overhead trolley construction being the first of all catenary installations to operate regularly at 11,000 volts, almost all of the details had to be designed especially for the equipment. Nearly all of the construction is of the side-pole and bracket type, exceptions being found at sidings and railroad yards. A No. 4—0 grooved copper contact wire is supported at intervals of 10 ft. by hangers suspended from a seven-strand 7/16-in. steel "messenger" cable supported by the brackets. Each bracket consists of a 3-in. x 2.5-in. tee 10 ft. long, the heel of which is fastened to the wooden pole by a pair of bent straps, the outer end being supported from the pole-top by two ⅝-in. steel truss rods, instead of the single rod commonly used in bracket work. The insulator used at each bracket is of Thomas manufacture, 6⅞ ins. in diameter, and 6 in. high. It is of the three-petticoat type, but is made in two parts held together by a quick-setting cement of litharge and glycerine.

On straight track the poles are placed at intervals of 120 ft., but on curves the intervals are somewhat shorter. The maximum deflection from the center line of the track, on curves, is 7 ins. each way. The catenary hangers are of the Electric Railway Company's drop-forged type, being modified by the engineers to suit the requirements. The messenger clip and the trolley clip are of the same type but grooved differently to accommodate their respective wires. They are joined by a ⅝-in. iron hanger-rod, with right-hand threads on each end, the longer rods being flattened in the middle to admit of bending them slightly, so as to conform to the divergence of the messenger and trolley wire near the ends of the spans. Both

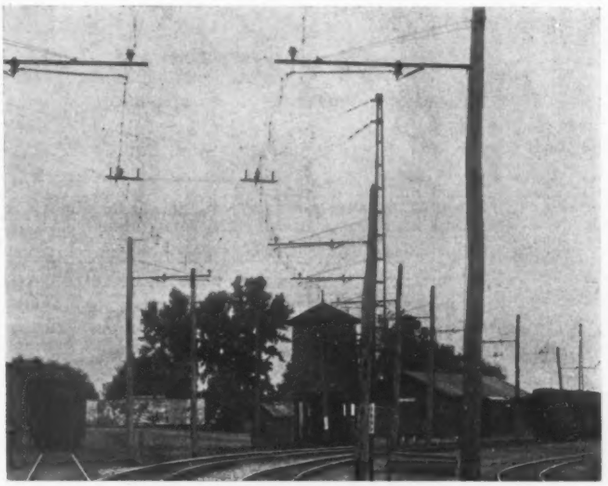


FIG. 4.—OVERHEAD CONSTRUCTION AT MT. MORRIS TERMINAL.

the trolley and the messenger ears are secured in position by jam nuts. This type of suspension was developed especially for this installation, and is so constructed that there is no possibility of parts coming loose and falling apart on account of vibration. It is also very quickly and easily adjustable on the trolley wires.

The steady-strain rods, which are of treated wood, are mounted at one side of the bracket instead of directly underneath, in order to give sufficient clearance for the pantograph trolley on curves, where the super-elevation results in the tilting of the shoe from the horizontal. Each steady-strain

FIG. 5.—SIDING AT MORTIMER, SHOWING OVERHEAD CONSTRUCTION, SWITCH TOWER, SIGNAL AND SWITCH LOCK.

rod is hinged to a spool-type Thomas porcelain strain insulator, which is clamped to one side of the bracket in such a manner that the hinged end of the rod is almost at the elevation of the top of the tee bracket. The method of attaching the steady-strain insulators to the bracket is such that they can readily be shifted along the bracket to follow up any change in alignment of the trolley wire that may be required by curvature or for any other reason. The clamps holding the

steady-strain insulators are of 3 in. x ⅜ in. bent iron. The spool-type insulators are cemented on to pieces of ¾-in. pipe, through which passes the ⅝-in. eyebolt by means of which they are attached to the bent irons. Steady strains are used only on curves and turnouts; they were not found necessary on tangent track.

The span constructed is as nearly as possible similar to the bracket construction, the same type of pin and insulator being used. A 3 in. x 2½ in. tee about 30 ins. long is suspended from the span wire by hangers of galvanized strand cable, adjustable in length, and fastened to the span wire cable by specially designed clips, the construction forming a sort of stirrup upon which the pin and insulator are carried. The messenger wire rests upon the insulator just as in the case of regular bracket construction. This form is used, not only for spans where there is only one track, but also in the yards at Avon, and Rochester, where three or four parallel tracks are electrically equipped. Span construction, in general, was used only where conditions absolutely required it.

For the extra long spans required in the Rochester yard, where it was impossible to use guys of the ordinary type, it became necessary to employ a self-supporting span construction, and this was accomplished by installing the "Tripartite" type of steel pole, set in concrete. This pole is constructed of re-rolled Bessemer steel rails, and it is less subject to rust, and consequently is more durable than any other available type of metal pole; moreover, all of its surfaces are always open and :are easily inspected. On account of the great tenstile strength of the material, there is considerable saving in weight, and the fact that it was a standardized product, enabled quicker delivery to be made than though special riveted poles of structural steel shapes had been especially designed for these locations. The span wires consist of the regular messenger cable fitted with cable sockets sweated on at each end, the same being fastened to turnbuckles and pole collars at the tops of the poles. There are two span cables at each pair of poles, the upper one being used to carıy the weight, the lower one acting to steady the arrangement and also serving as a relay in case of an accident to the upper span. Similar construction was also used at Avon, where guying of the side poles was not always possible.

the messenger and the trolley wire is easily adjusted to suit the conditions, by shifting the spool-type insulator up and down the spacing rod, by inserting longer or shorter nipples of pipe underneath it. In general, where it is near a span wire, the messenger cable is supported rigidly on its insulator and the trolley wire needs all the side pull; but in the middle of a span the pull must be equally divided between the messenger and the trolley wire.

The presence of several through-truss bridges over streams, and two low bridges over the Erie right of way, necessitated the employment of special construction at these points, particularly at the bridge at Clarissa Street, on the outskirts of Rochester. The original clearances here were so low that the road-bed had to be excavated out and the track lowered about 2 ft., the minimum clearance between the rails and the trolley wire being finally 18 ft. The messenger is fastened to a horizontal spool-type insulator mounted at the center of a substantial piece of turned oak, which is long enough to carry two more similar insulators, one on either side of the center one.

The steel hangers reaching down from the overhead bridge structure carry the two side insulators, so that there are always two insulators in series between the 11,000-volt messenger cable and the steel parts of the bridge. These insulated supports are suspended at short intervals from the under side of the bridge, and are further supplemented by the use of steady strains which prevent any side displacement of the trolley wire. The sortest sizes of hanger spacing rods are used in such places. Where the bridge trusses are high enough to permit it, an iron stirrup is employed like that used in span work, which carries the standard form of straight-line insulator, and the regular type of catenary suspension is employed.

TELEGRAPH SYSTEM.

As is well known, the single-phase trolley system causes interference with telegraph lines along the right of way, and unless both the electrostatic and electromagnetic induction are properly compensated there is always danger of telegraphic communication being seriously affected. The electrostatic effect is particularly annoying, as it is absolutely continuous as long as the trolley line is charged, whether or not there are any cars moving. Various means were proposed and tried by the

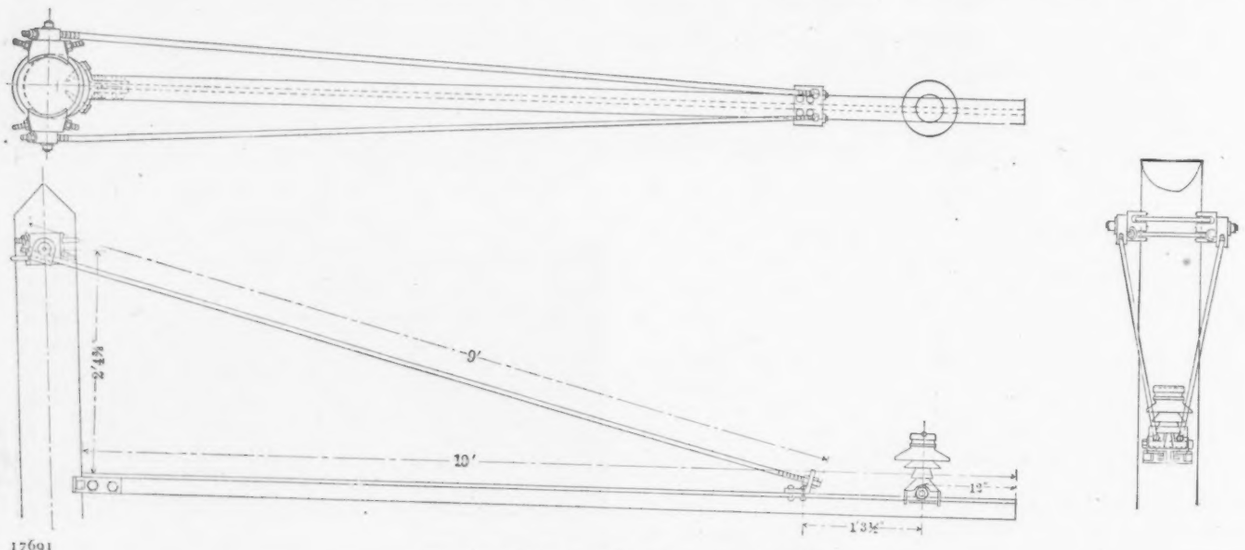


FIG. 6.—DETAILS OF BRACKET CONSTRUCTION.

A very simple type of pull-off was devised for the curves in the span construction, and it so happened that both the Rochester and the Mt. Morris yards have considerable curvature. The pull-off consists simply of a spool-type insulator, with a pipe cemented through the center; the pipe is slipped over the hanger spacing-rod joining the messenger and trolley clips, thus giving an insulating connection through which an ordinary pull-off cable can be attached to both the messenger and the trolley wherever required. The division of the horizontal pull between

Western Union Telegraph Company for the elimination of the "static," which always causes the telegraphic relays to chatter, but the most successful thus far known is that due to E. W. Applegate, quadruplex expert for the Western Union Telegraph Company, who has developed a very simple means for overcoming static interference. Mr. Applegate worked upon the theory that it is useless to try to compensate for the electrostatic influence, and that it is best to "pacify" the instrument by additional devices.

The Applegate "static pickup," for which a patent has been applied, comprises a back contact relay and a high resistance shunt. The current enters the relay 1 and 2 through a 150-ohm magnet coil attracting the armature *C*. When the line opens by any operator opening his key the armature *C* falls back and through the back contact connects point *C* and *D* by the aid of a spring *S*.

The shunt *A* consists of 350 ohms of carbon stick, and provides a better path for the static electricity than do the magnets, pacifying the magnets to a certain extent. When the line opens and the armature connects with the back stop *C* and *D*, both the *A* and *B* shunts are in with the main line and pick up the static electricity which escapes through shunt *A* to the ground, relieving the agitation of the armature so that it can respond to the closing of the line.

The shunt *A* robs the relay of main line battery current very materially, so that it responds to the home key sluggishly. Consequently the auxiliary battery *F* is inserted in shunt 2. When the armature *C* falls back this battery acts upon the magnets and assists their prompt response to the home key or to any other operator to such an extent that the shunt *A* does not cause noticetble drag. No matter what the line "static" may be these shunts "pacify" the instruments and the "static" is not felt.

The armature spring is adjusted high enough to overcome the wave of "static" that escapes *A* and *B* shunts. The aid of the 7-volt battery overcomes this adjustment and leaves the relay very prompt and satisfactory.

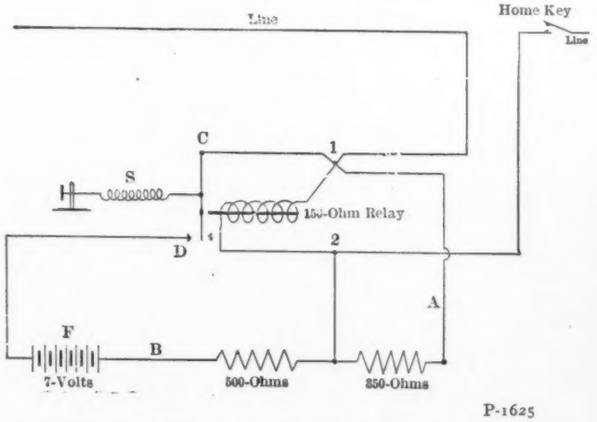


FIG. 7.—CIRCUITS OF BACK-CONTACT TELEGRAPH RELAY.

The arrangement has proved so successful that all telegraph wires are now operated "single," with ground return, instead of in "metallic circuit," as it was at first feared would be necessary. The telegraph department of the railroad company, in connection with the signal department, constructed a private telephone line of two copper wires between Rochester and Avon, with instruments at all signal towers and stations in the dispatcher's office, and at the sub-stations, and car shed, and master mechanic's office. This telephone system is run upon the trolley bracket poles, transposed every third pole, and has worked satisfactorily.

SUB-STATION EQUIPMENT.

The energy for operating the motor-cars is transmitted at 60,000 volts from the Niagara Falls station of the Ontario Power Company, to a sub-station at Avon, about 19 miles south of Rochester. The sub-station equipment consists of three 750-kw single-phase, oil-insulated, water-cooled transformers. Two of the transformers are aranged for T-connection for changing the three-phase current at 60,000 volts to two-phase current at 11,000 volts for the trolley circuits. The third transformer is held as reserve. The cooling water is circulated by gravity, the supply coming from the railroad company's water-tank system at the adjacent round house, being pumped originally from the Genesee River about a mile distant.

The necessary transformation from three-phase to two-phase fits in very well with the natural subdivision of the electrically equipped line into two sections, one of which is about 19 miles in length, north of Avon, the other about 15 miles in length, being to the south of Avon. The connections were therefore laid out to operate such sections upon separate phases of the

FIG. 8.—SUB-STATION AT AVON.

two-phase secondary system. One of the three secondary terminals is grounded to the rails. The two free terminals which pass to the separate trolley sections are protected by low-equivalent lightning arresters reinforced by electrolytic lightning arresters. A set of call bells is provided so that when the automatic breakers open, a bell is rung in the car-inspection shed, adjoining. Also, if the temperature of any transformer runs above normal, a bell circuit connected to a

FIG. 9.—MAIN TRANSFORMER ROOM, AVON SUB-STATION.

thermometer in the top of the transformer tank is similarly made to operate. The station itself does not require the continuous presence of an attendant, which is needed in the case of a rotary-converter sub-station. The working force is so organized that the car-repair men are always available for

manipulating the sub-station circuit breakers, and the cost of attendance is thereby reduced to a minimum.

OPERATION.

The equipments above described were intended to be sufficient for operating single-car trains with one stop per mile, over the entire road, at an average schedule speed of 24 miles per hour, or to haul one trailer, making stops about 2½ miles apart at the same schedule speed. The company has furnished shelters where the public highways cross the line, there being 22 of these flag stations besides the regular intermediate way-stations at which steam trains stop, 6 in all, or a total of 28

FIG. 10.—SINGLE-PHASE MOTOR.

stations at which electric cars may be required to stop. Practically the electric cars stop at all the regular way-stations, but at only a portion of the flag stations. A single passenger

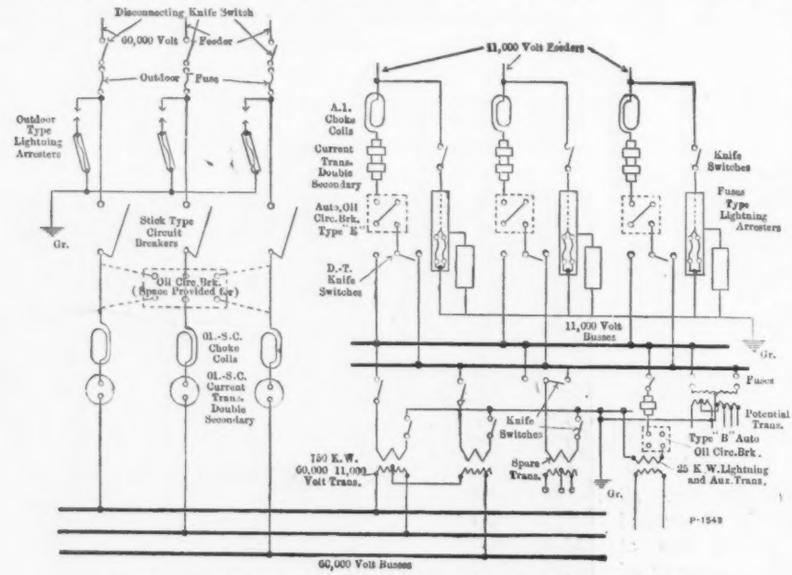


FIG. 11.—DIAGRAM OF CIRCUITS IN TRANSFORMER SUB-STATION.

coach is frequently attached to a motor-car, and on some trains baggage, milk or postal cars are regularly hauled. When two trailers are hauled two motor cars are required, making a four-car train, as shown in the attached photograph. The service has proved immensely popular throughout the Genesee Valley, through which it passes, and it is intended to increase the number of motor-cars in order to handle the business a little more comfortably next season. It is found that the electric trains on the 34 miles of line can be depended on to keep to their running time rather better than the steam passenger and freight trains operating over the main line.

ORGANIZATION.

The single-phase system was recommended for the electrification of this division by the Electric Traction Commission of the Erie Railroad, and after authorization by the company, was installed under the general direction of J. M. Graham, vice-president and head of the construction department of the Erie.

The engineering and the construction work were carried out and the system brought into operative condition by Westinghouse, Church, Kerr & Company, who designed and erected the buildings and the catenary trolley construction, bonded the track and installed the electrical apparatus in the sub-station and on the cars.

The adjustment of the telegraph system was carried out

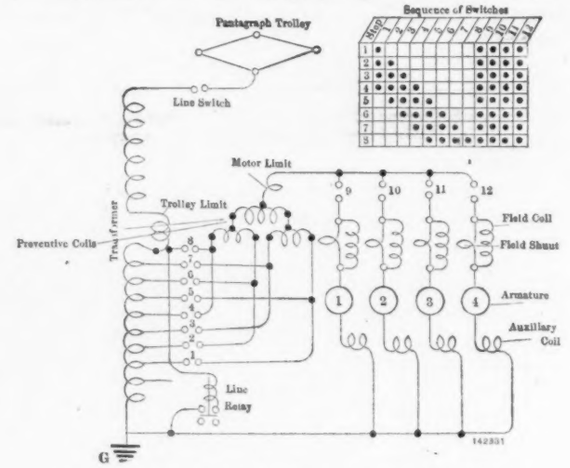


FIG. 12.—DIAGRAM OF CONTROLLER CONNECTIONS.

jointly by the Western Union Telegraph Company and the telegraph department of the railroad company.

The order was given to the engineers on June 6, 1906, and although the intense activity in construction work all over the country at that time rendered it difficult to secure materials and labor promptly, the work was pushed so rapidly that about 7½ months later, on Jan. 22, 1907, the first official trial trip was run between Avon and Rochester. The severe winter weather thereafter prevailing delayed the completion of the work until spring. During April and May the whole equipment of sub-station apparatus, lines and cars was thoroughly tried out in a course of experimental operation, which also enabled the railroad employees to become familiar with the new system. On June 18 commercial operation began and has since continued permanently with marked success.

The Erie is one of the oldest steam railroads in the country, but that it is also one of the most progressive is demonstrated by its policy of giving a thorough trial to a system of electric traction whose characteristics of simplicity in construction and economy in operation make it so eminently fitted to replace steam motive power wherever the economic conditions point to the desirability of its substitution for the betterment of either passenger or freight service.

Recent Electrochemical Developments—The Edison Storage Battery.

By looking over the numerous patents which have recently been issued for the Edison storage battery one is impressed by the enormous amount of detailed ingenious experimental work which has been done by Mr. Edison. It reminds one of his favorite saying that inspiration is only another way of spelling perspiration. Besides the general construction of the battery, details of the relief valve and gas separator, which are already well known, two special features have been revealed by his recent patents. One is the method of making seamless battery cans, the other the method of mixing flake cobalt-nickel with the active material for the sake of improving the conductivity.

The manufacture of seamless steel cans is carried out by electrolytic deposition in a number of steps, each of which is

important for the success. Hollow brass or copper molds of the proper form are first coated with an exceedingly thin layer of paraffine wax, over which a coating of graphite is applied. The layer of wax is so thin that the graphite apparently makes contact through the wax with the mold. A coating of copper of about 0.004-in. thickness is then applied electrolytically. The mold is then removed, washed and introduced into a second tank, where it receives an electrolytic coating of nickel about 0.001 in. thick. Then it passes into a third tank containing a neutral ferrous ammonium sulphate solution with iron anodes. Here it receives an iron coating of about 0.02-in. thickness. In order to prevent the formation of pits or holes in the deposited iron coating, which would be likely to form by the accumulation of gas bubbles thereon, and in order to secure a very smooth surface, a quantity of crushed charcoal is introduced into the solution, whereby the added material will rub over and scour the surface of the deposited metal, polish the same and wipe off any gas bubbles which may tend to accumulate. During the iron plating the mold is rapidly revolved at a speed of about 1½ revolutions per second. The mold is then removed from the tank and washed in water of a temperature of about 75 degs. C., thereby melting the wax originally deposited on the mold. The deposited can is then removed from the mold and is annealed by heating it to a red heat in a closed retort containing a non-oxidizing atmosphere, such as hydrogen gas. After annealing, the articles are allowed to cool in the same atmosphere. Finally, the copper originally deposited on the graphite is removed by filling the can with a solution of copper nitrate and sodium nitrate and using the can as an anode against a copper cathode.

It is quite evident that in this long process, which is, of course, carried out by automatic machinery, not a single step is superfluous. The wax coating on the mold is applied to permit later an easy removal of the deposited can from the mold. The graphite coat serves for making the surface conductive. The copper coat is necessary because a nickel deposit would not stick to the graphite. The nickel is necessary on account of the caustic soda electrolyte of the battery. In depositing the iron, the use of the small particles of crushed charcoal not only serves for wiping off the gas bubbles, but also for incorporating a small percentage of carbon with the iron. In the subsequent annealing process the iron gets the necessary strength and, on account of the small percentage of carbon incorporated with it, it is, in fact, converted into a superior product of soft steel containing almost 0.4 per cent of carbon.

It was early recognized by Mr. Edison that in order to get high conductivity of the active mass in the little pockets of his storage battery plates, it was necessary to mix the active mass of nickel hydroxide with some material of good conductivity. Flake graphite was first used, but in the course of a long time it was found that the flake graphite undergoes a change in its contact resistance and the capacity of the battery is thereby diminished. Mr. Edison now uses flakes of a nickel-cobalt alloy, containing, say, 60 per cent of cobalt and 40 per cent of nickel.

Of the numerous patents for the production of these flakes or films it will be sufficient to describe the method revealed in the last patent. A copper cylinder with a polished nickel-plated surface is first immersed in a suitable cobalt plating bath, and while the cathode is revolved a thin film of cobalt 0.0001 in. or less in thickness is plated on the cathode. This is then washed and placed in a solution of copper sulphate containing some free acid, whereby the cobalt is caused to go into solution and the copper is deposited as cement copper in granular, but slightly adhesive form. The cylinder is then placed in a copper plating bath and an electro-deposit of copper 0.003 in. to 0.0035 in. thick is obtained on the cement copper, while the cathode is rotated. It is then washed and introduced into a bath consisting of a mixture of chloride of cobalt and chloride of nickel, and a cobalt-nickel alloy deposit is obtained about 0.0002 in. thick. The cylinder is again washed, and a second film of copper is deposited, then another film of cobalt-nickel, and so on, producing electrolytically alternating layers of copper and cobalt-nickel, until a composite sheet of sufficient thickness has been obtained. This sheet is cut longitudinally of the cathode into small strips which are placed in a basket and introduced into an ammoniacal solution of copper sulphate and moved up and down in this bath. The copper is thereby dissolved, while the nickel and cobalt are not attacked, so that the desired films or flakes of cobalt-nickel are obtained.

New Telephone Patents.

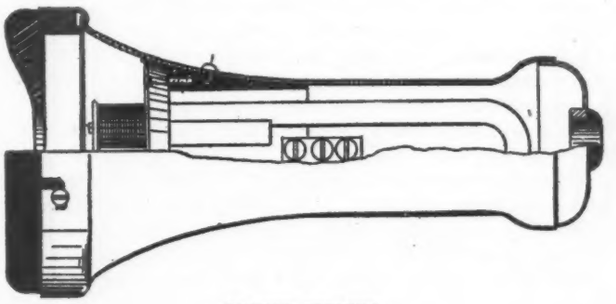
SELECTOR FOR AUTOMATIC EXCHANGES.

Selectors for automatic exchanges have several well-defined functions to perform. In every case the switching mechanism must be advanced by a ratchet arrangement responsive to electrical impulses; the mechanism must be stationary between impulses so that their effects will be accurately cumulative, and again the whole apparatus must be released at will to return to zero position. Usually these combined functions have involved a differentiation of circuits and the provision of two or more magnet actions.

Messrs. C. E. Scribner and C. D. Enochs have, however, recently patented a selector in which one magnetic action and one arrangement of circuit suffices. As usual, the operating magnet oscillates a pall which engages a ratchet to advance this latter one step or tooth for each vibration of the pall. The ratchet is, however, secured to a massive disc which moves with it, a weighted arm tending to resist the forward movement under action of gravity. The inertia of this mass is so great that the unbalanced force is not able to generate appreciable return motion between successive impulses from the pall. When the pall is withdrawn a considerable time, however, the ratchet returns to zero. The patent for this apparatus is assigned to the Western Electric Company.

METAL SHELL RECEIVER.

There is shown below a metal shell patented by E. J. Quinby, of Portland, Maine. The ear cap is of hard rubber



QUINBY RECEIVER.

and slips within the edge of the casing. It will be seen that the magnetic system is insulated from the shell, being mounted upon a hard rubber bushing, which is secured in the proper position within the casing.

Letters to the Editors.

Switchboard Connections of Wattmeters and Watt-hour Meters.

To the Editors of Electrical World:

Sirs:—Referring to Mr. MacGahan's article in your issue of Sept. 14, on "Switchboard Connections of Wattmeters," I would like to ask Mr. MacGahan how he would determine whether the power factor on a three-wire, three-phase system was above or below 50 per cent. If the table is carried below 50 per cent power factor, the ratios of readings are the same as they are from unity to 50 per cent.

In determining the voltage connections Mr. MacGahan is in

error in his statement at the top of the second column on page 538. There would be no voltage across 3-4 unless 1 and 2 were connected together, and if they were, then the voltage across 3-4 would be the same as that across 1-3 or 2-4.

On small installations a bank of transformers and one or two motors, with the watt-hour meter on the primary, we have found that the starting power factor at the instant of throwing in the switch is above 50 per cent and the slow side of the meter should be connected to rotate forward at this instant; but in the case of large installations the bank and meter are so large in comparison to the size of the motor that this method is not certain. I would like to ask Mr. MacGahan what he would do in such a case.

Buffalo, N. J. Henry H. Lyon.

To the Editors of Electrical World:

Sirs:—Referring to Mr. Henry H. Lyon's letter concerning the article by the undersigned in your issue of Sept. 14 on "Wattmeter Connections," I am sorry to note that an error has crept into the text, as indicated by Mr. Lyon. The second column of page 538 should read in part as follows:

"The connections should be tested when the load is on and the power factor is higher than 50 per cent. First, the voltage at the shunt binding posts 3-4 should be equal to that on 1-3 and 2-4, the leads 1-2 being connected together for the purposes of this test. If voltage 3-4 is 1.73 times voltage 1-3 and voltage 2-4, one of the voltage transformers must be reversed."

Mr. Lyon brings up the point that there may be cases when the power factor can be reasonably suspected of being below 50. In such cases an additional test is necessary to determine whether the power factor is above or below 50. I would suggest the following method of procedure, which is based on the fact that the sum of the two readings should be positive, so long as the power is in the positive direction. When the currents in the voltage and series coils, as indicated by the clock diagram, are in the same direction, or within 90 deg. of being in the same direction, the meter will read forward. When the current in the series coil is more than 90 deg. out of phase with the voltage, the meter will reverse.

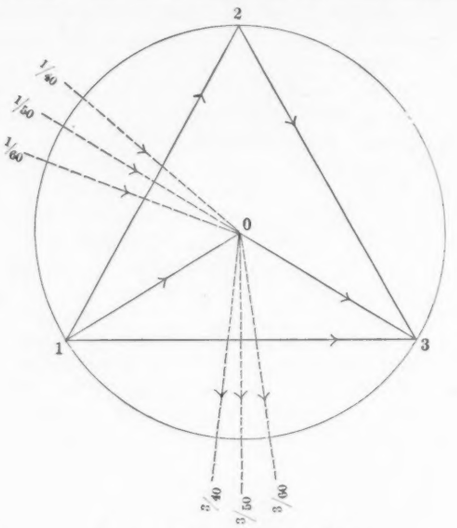
1. By proper testing with an incandescent lamp or a voltmeter obtain three voltage leads, 1, 2, 3, having equal voltages between them.

2. Connect these leads to the voltage circuits of the wattmeters as previously indicated.

3. Connect the series transformer in line 1 to meter *A*, whose shunt is connected to 1-2, and series transformer in line 2 to meter *B*, whose shunt is connected to 2-3. (See clock diagram giving the phase relations.) In this diagram 1-2 represents the voltage in meter *A*, 2-3 the voltage in meter *B*, 1-0 the current in meter *A* and 0-3 the current in meter *B*.

4. Change voltage connections from 1-2 to 1-3 on meter *A*. If power factor is 100, the readings will be alike with both connections. If the power factor is less than 100 and greater than 50, the readings will differ, but be in the same direction (either both positive or both negative). If equal to 50, one of the readings will be 0. If less than 50, the readings with 1-2 and with 1-3 will be reversed in direction, with respect to each other.

5. The same test may be performed on meter *B* by changing the voltage connections from 2-3 to 1-3. If the power factor is 100, the readings will be alike. If less than 100 and more than 50, the readings will differ but be in the same direction. If equal to 50, one of the readings will be 0. If less than 50, the readings with connections 1-3 and 2-3 will be reversed in direction, with respect to each other.



0-3	Current in Meter B at 100%	P.F.
0-3/60	" " " " "	60% "
0-3/50	" " " " "	50% "
0-3/40	" " " " "	40% "
1-0	" " " A "	100% "
1/60-0	" " " " "	60%
1/50-0	" " " " "	50% "
1/40-0	" " " " "	40% "

DIAGRAM OF PHASE RELATIONS.

6. If it is found from the above tests that the power factor is greater than 50, connect the series coil of the watt-hour meters so that both revolve forward. If the power factor is less than 50, connect the series coil of the slower meter so that meter rotates backward and the series coil of the faster meter so that it rotates forward.

The above description indicates the use of two single-phase meters, but holds equally true for a polyphase meter consisting of two single-phase meter elements driving the same shaft.

Pittsburg, Pa. Paul MacGahan.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Alternating-Current Motors.—H. Goerges.—A translation in abstract with illustrations of his German paper recently noticed in the Digest on a general theory of alternating-current motors. The author explains the action of single-phase and polyphase alternating-current motors by resolving the magnetic flux through the rotor into two components, displaced relatively to each other by 90 electrical space degrees. The rotor winding is similarly split up into two components, whose magnetic axes coincide with those of the fluxes. The rotor currents are divided into free, externally influenced, and forced currents, and the classification of motors is based on the nature of the rotor currents. The theory is applied to the following four principal types: The induction, the series, the series-short-circuit and the repulsion motor.—Lond. *Electrician*, Sept. 13.

Field Magnet for Turbo-Alternators.—Details of construction of rotating-field magnets of cast steel for turbo-generators, recently patented by a British company. The magnet is divided into two parts in such manner as to facilitate the winding of the field coils.—Lond. *Elec. Eng'ing*, Sept. 12.

Special Alloys for Transformer Sheets.—R. Pohl.—A translation with illustrations of his German paper on the design of transformers as influenced by the use of special alloy steels, which was abstracted some time ago in the Digest.—Lond. *Elec.*, Sept. 13.

Predetermining Direct-Current Dynamos.—H. M. Hobart and A. G. Ellis.—Continuation and conclusion of their fully illustrated article on a method of determining the leading dimensions of large and high-speed direct-current dynamos.—Lond. *Elec. Review*, Sept. 13 and 20.

Commutating Poles.—H. ZIPP.—An article discussing with the aid of diagrams the influence of commutating poles on the behavior of generators and motors.—*Elek. und Masch.*, Sept. 8.

Lamps and Lighting.

Cheap Metallic-Filament Lamps.—It is announced that the incandescent-lamp syndicate in Continental Europe (Verkaufsstelle der Vereinigten Glühlampen Fabriken) of Berlin "has decided to introduce a metallic-filament lamp which will economize the consumption of power. The economy as compared with that of the carbon-filament lamps will be 30 per cent, and the useful life will be about 500 hours. It is stated that the price of the new lamps will be only a few pfennigs greater than that of the normal lamps." (One pfennig is one-fourth cent.)—Lond. *Elec. Review.*, Sept. 20.

Tungsten Filament.—A reprint in full of a recent patent specification of the British Thomson-Houston Company for making filaments of tungsten, molybdenum, titanium, etc. In case of tungsten a block or rod consisting of pure tungsten powder is pressed into shape under heavy pressure. It is then treated in an electric furnace in which a vacuum is maintained by means of a pump, the lower end of the tungsten rod being inserted in a quantity of ductile metal such as amalgam, etc., which rests on the bottom of the furnace. After the air has been exhausted the tungsten rod is brought into contact with the amalgam. It is then lifted and an arc is established between the tungsten and the vaporizable amalgam below it, which is made the cathode, direct current being used. The tungsten rod, being the anode, gives off considerable quantities of occluded air and other gases and these are taken out through the pump, so that after some minutes of operation the tungsten rod is in a clean and porous condition. The tungsten rod is then suddenly lowered into the amalgam which then percolates through the tungsten and completely fills up all the minute pores in the stick. The quantity of amalgam or other ductile metal taken up by the tungsten stick depends on the degree of subdivision of the tungsten powder and also on the extent to which it has been compressed. In color the impregnated stick generally resembles the ductile material. A special method for impregnating the tungsten stick with copper is also described. After having thus been impregnated, the tungsten stick may be subjected without further treatment to a sintering or soldering action by passing a strong current through in a vacuum or inert atmosphere. The less refractory metal with which the tungsten is impregnated is thereby vaporized, and it is found that the resultant stick is much stronger and better suited for use as a filament than the original stick of pressed or untreated material. It is, however, also practical to roll or draw the impregnated stick much like a pure metal of fair ductility and by careful handling it is possible to convert the sticks into plates or foil or into wires and strips of the size now used in incandescent lamps. All this may be done even though the original refractory stick is pressed up from a nonherent and finely-divided powder.—Lond. *Elec. Eng'ing*, Sept. 12.

Tungsten Lamp.—A note on a recent patent of the Allgem. Elek. Ges. Tungsten filaments for electric lamps are prepared from colloidal tungstic acid by mixing the acid with a binding material such as starch. The resulting paste is squirted into the form of filaments, which are then reduced to metal by heating to a high temperature in hydrogen. In consequence of the omission of an organic binding material the finished filaments are quite free from carbon.—Lond. *Elec. Eng'ing*, Sept. 12.

Boron Filament.—A full account of a British patent specification of the British Thomson-Houston Company for making boron filaments for incandescent lamps. Boron nitride is heated in a vacuum to a temperature above 1500 deg. C., whereby it is decomposed, the nitrogen being carried off by means of the pump. There is thereby obtained pure boron, which is quite different from the boron heretofore described in text books. It is electrically conductive, and can be melted at exceedingly high temperatures without volatilization. To make filaments the boron is pressed into a rigid rod or stick or is mixed with a small quantity of vaporizable binder such as paraffin so that it may be squirted into the form of a filament. The binder is then removed by direct vaporization. In case an organic binder is used, one is chosen which completely vaporizes without leaving carbon in the boron.—Lond. *Elec. Eng'ing*, Sept. 12.

Accidents Due to Various Systems of Lighting.—A note on statistics of the accidents caused by various illuminants during 1906 in Germany. The following table takes into account only the accidents which happened to people; those which caused fires and explosions, but no other serious injury, have been excluded:

	NATURE OF LIGHTING.					
Accident.	Gas.	Electricity.	Petroleum.	Alcohol.	Paraffin.	Acetylene.
Slight	112	42	199	119	53	24
Serious	149	46	218	140	62	34
Fatal	41	35	127	58	13	10

Therefore 44.4 per cent of the fatal accidents were caused by petroleum, 20.3 by paraffin, 14.3 by gas and only 12.2 by electricity. The greater part of the fatal accidents due to electricity were caused by carelessness, foolhardiness or drunkenness. Only two were actually due to leakage.—Lond. *Elec.*, Sept. 13.

Power.

Turbo-Alternators.—The first part of an illustrated description of the standard types of turbo-alternators and turbo-dynamos built by Brown-Boveri & Company.—Lond. *Electrician*, Sept. 20.

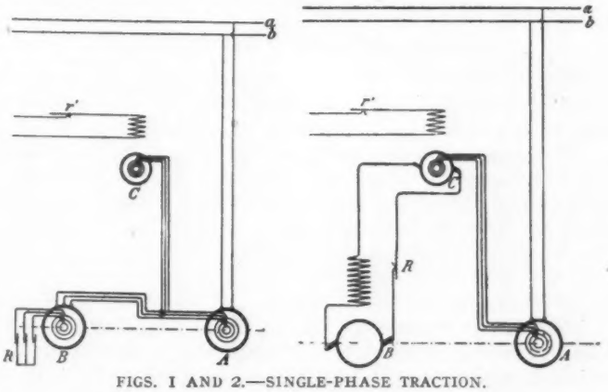
Swiss Hydro-Electric Station.—An illustrated description of a water-power station, which was established recently not far from Engelberg, principally for the supply of electrical energy in Lucerne. A fall of about 1000 ft. is available. Three main 2000-hp generating sets are installed. The alternators are arranged to run either as three-phase or single-phase, for the motor or lamp service, respectively. The switch gear, which includes oil switches on both the 6000-volt and the 27,000-volt sides of the step-up transformers, is very complete. Cellular construction is used throughout, with bare bus-bars, supported on insulators.—Lond. *Elec. Engineering*, Sept. 19.

Electric Machinery in Mines.—An article on the construction of fire-proof and explosion-proof machinery for mines, dealing especially with the construction and installation of the switch gear, the motors and the transformers.—Lond. *Elec. Review*, Sept. 20.

Superheated Steam.—O. H. WILDT.—The first part of a very long article on the use of superheated steam in generating stations.—*L'Industrie Elec.*, Sept. 10.

Traction.

Single-Phase Traction.—A. HEYLAND.—A long paper read before the recent meeting of the German Association of Electrical Engineers. The author first sketches the general development which resulted from the introduction into practice of single-phase commutator motors. He then endeavors to show



FIGS. 1 AND 2.—SINGLE-PHASE TRACTION.

that no essential further progress can be expected from commutator motors and that it is doubtful whether the results which have been accomplished will be sufficient to justify the use of the single-phase commutator motors for heavy traction. In the second part of the paper various combination arrangements are

described in which simple single-phase induction motors with slip rings and without commutator are used. The fundamental idea is to connect in parallel with the rotor circuit of the motor an excited but unloaded auxiliary motor. This arrangement is of special advantage in connection with two motors in cascade, the excited unloaded auxiliary motor being inserted between the two main motors. Such an arrangement is shown in Fig. 1, where *A* is the first single-phase induction motor being directly connected to the transmission line *ab*. *B* is the second induction motor and between the two the auxiliary unloaded motor, *C*, is connected. The resistance *R* is used for starting. A second arrangement is shown in Fig. 2, in which *A* is again a single-phase induction motor directly connected to the line. *C* is a motor-generator consisting of a three-phase motor and a direct-current dynamo with independent excitation. *B* is a direct-current motor. A third arrangement which the author seems to consider as the most advantageous one is shown in Fig. 3, where *A* is the first single-phase induction motor,

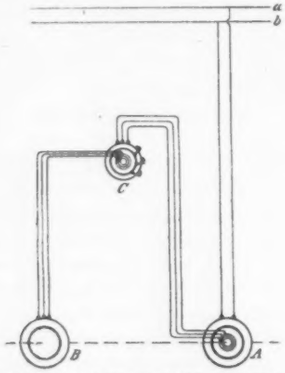


FIG. 3.— SINGLE-PHASE TRACTION.

which is directly connected to the line *ab*. *B* is a second induction motor, the secondary of which is short-circuited, and *C* is the auxiliary motor which is used as a frequency converter. —*Elek. Zeit.*, Sept. 12 and 19.

Electric Traction on Railways.—P. Dawson.—In a continuation of his very long and fully illustrated serial on electric traction on railways, the author takes up the subject of running curves. He first considers the construction and use of the kilowatt-speed curve of a motor, the tractive-force speed curve and the time-tractive-force curve from which the other two are derived. The value of such curves is shown by a practical application to part of the London, Brighton & South Coast Railway. The effect of varying the gear ratio is then considered, and the derivation of the curve giving the load on the generating station for a given service. Polar curves are the most convenient for this purpose, as is shown by an actual example. The effect of revolving masses is then considered.—Lond. *Elec.*, Sept. 13 and 20.

Installations, Systems and Appliances.

Manchester.—An abstract of the last annual report of the municipal electric works of Manchester. There are three separate works with an aggregate rating of 33,800 kw. The total number of kw-hours sold during the year were 47,564,903, of which 24,786,457 were sold for tramways and the balance for private lamps and motors and public lamps. The total cost per kw-hour, including capital charges, was 3.242 cents, while the corresponding income from all sources was 3.508 cents.—Lond. *Electrician*, Sept. 13.

Electricity on Board of Steamer.—An illustrated description of the electric installations on the White Star liner *Adriatic*. There are a gymnasium with a number of motor-driven appliances, a radiant heat bath, and many other applications of electricity. Its generating plant consists of five 75-kw sets. There are over 3000 lamps, and about 50 motors of various sizes.—Lond. *Elec. Eng'ing*, Sept. 19.

Improving a Small Power Load.—H. S. Hatfield.—The chief obstacle to an increased use of cheap energy by the average private lighting consumer is that the supply for energy must be separately metered and it is necessary either to install a separate circuit for the purpose or to use a sub-meter. The author strongly favors the latter method and describes an instrument suitable for this purpose which is a miniature mercury electrolytic meter registering either, first, the energy consumed by a tapping taken from the plug and connected to another plug or direct to a radiator, etc., or, second, energy consumed by an appliance plugged in on the lid of the meter.—Lond. *Elec.*, Sept. 13.

High-Tension Condensers.—J. Schmidt.—The first part of a serial on different applications of high-tension condensers. The first installment deals with the use of a condenser for overcoming the phase-difference and resonance phenomena in distribution networks.—*Elek. Anz.*, Sept. 8.

Safety Regulations.—The complete set of the new safety regulations for electric installations adopted by the Association of German Electrical engineers. They will be in force beginning with Jan. 1, 1908. Several points in the regulations are explained in an article by K. Wilkens.—*Elek. Zeit.*, Sept. 12.

Wires, Wiring and Conduits.

Sag of Lines.—G. Nicolaus.—The selection of the proper sag of a line is one of the most important requirements for the best erection of a telegraph line. The author in a long article gives diagrams with curves which permit a graphical solution of all problems referring to the equilibrium condition of overhead lines.—*Elek. Zeit.*, Sept. 12 and 19.

Insulating Varnishes.—A. R. Warnes.—An article on insulating varnishes pointing out the very dangerous effect of the use of linseed oil in such varnishes, and describing experiments which show these effects.—Lond. *Elec. Review*, Sept. 20.

Junction Box.—An illustrated description of a junction box for metallically sheathed electric cables recently patented by an English telegraph company. The mechanical details of the arrangement are described and illustrated, showing that good electrical contact with the sheathing is insured.—Lond. *Elec. Eng'ing*, Sept. 19.

Soldering.—A. Lippmann.—The first part of a translation in full of his German article on experiments with solders for electric wires which was recently abstracted in the Digest.—Lond. *Elec. Review*, Sept. 20.

Switches.—Illustrated descriptions of various forms of multiple-contact, two-way and other special types of switches and combined switches and wall sockets, made by a British company.—Lond. *Elec. Eng'ing*, Sept. 19.

Electrophysics and Magnetism.

Oscillations in Direct Currents.—A paper referring to the work of Athanasiadis on the telephone sounds produced by direct-current dynamos with large capacities in the circuit. The author found that such tones were produced as soon as he inserted into the circuit a horseshoe electromagnet used for the study of diamagnetism. He even found them produced on inserting an accumulator with a resistance of manganin plates. With a current of 30 amperes the sound could be heard two or three yards off. The pitch of the note was in all cases equal to the product of the frequency into the number of segments of the commutator. This suggests that it is a temperature effect, produced by the alternating thermal expansion and contraction of the wire coils or manganin sheets, which is communicated to the air and then perceived as sound. The same effect may be produced by connecting up an arc lamp. In one case the note so produced was audible in every part of a hall capable of holding 150 people. This was all the more noteworthy since there was here no question of microphone currents.—*Ann. d. Physic*, No. 9, abstracted in Lond. *Elec. Eng'ing*, Sept. 1.

Electrochemistry and Batteries.

Electrolysis of Fused Salts.—R. Lorenz.—If fused salt, for instance, lead chloride, is electrolyzed with a fused lead cathode, it is found that lead dissolves from the cathode in the fused electrolyte in the form of a mist. The mist formation, of course, represents a reduction of efficiency. The author has found that this may be avoided by adding a chloride of an alkali metal to the electrolyte.—*Zeit. f. Elek.*, Aug. 23.

Units, Measurements and Instruments.

Alternating-Current Wattmeter and Voltmeter.—An illustrated description of new commercial forms of alternating-current instruments with iron cores as designed by Sumpner. By the use of laminated iron cores with narrow air-gaps in these instruments, strong magnetic fields are produced, thus permitting of the employment of strong controlling springs for the moving-coil system without loss of sensitiveness, and rendering the instruments proof against the influence of external magnetic fields. It was shown by Sumpner that the difficulties due to hysteresis and variation of permeability which had been expected to arise from the use of iron cores, could be overcome by suitable design, "and the series of instruments which has been developed in no way falls behind the ironless type in accuracy, while the comparatively strong forces at work enable the instruments to be constructed with substantial moving parts, pivots, etc." On account of the displacement of phase between the magnetic field produced and the voltage applied to a shunt-wound electro-magnet, it is necessary to use in connection with the current coil of the wattmeter a special "quadrature" transformer, the primary of which is traversed by the main current, while the secondary is connected through a high non-inductive resistance to the moving coil. Fig. 4 shows the connections of the wattmeter *W* and quadrature transformer *QT* on a single-phase circuit, *VV* and *AA* being the terminals of the field and moving coils, respectively, *P* the primary, and *S* the secondary of the transformer. For e. m. f.s above 600 volts, a voltmeter transformer is desirable. Apart from the use of the special type of ammeter transformer, the connections are the same as those of any other wattmeter. In addition to the two-wattmeter method for measuring the power in an unbalanced three-phase circuit, a single wattmeter can be used, with either a split choking coil in connection with the field coil, or two series transformers with opposed secondaries connected with the moving coil. The "magnetostatic voltmeter" is identical in construction with the wattmeter, but is employed with a condenser in series with a moving coil.—Lond. *Elec. Review and Elec. Eng.*, Sept. 13.

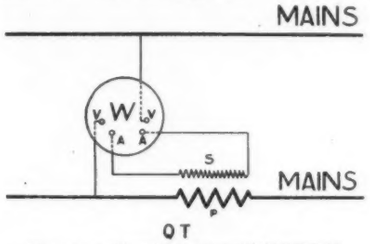


FIG. 4.—DIAGRAM OF CONNECTIONS.

Measuring Instruments.—A note on several improvements in electric measuring instruments which were shown at the recent exhibition of the French Physical Society. Richard showed a moving-coil ammeter provided with an arrangement for greatly extending its range. The pointer has a spiral spring attached to it whose free end comes in contact with a stop after the pointer has moved over a certain prearranged portion of the scale—for instance, up to the 100-amp. point. With any further increase in current the deflecting torque is opposed by the additional force of the spring, so that the motion of the pointer for a given rise in current is greatly reduced—the instrument indicating, for instance, up to 300 amperes in the last part of the scale. In the Meylan hot-wire meter the current to be measured does not exist in the hot wire, but in an insulated wire wrapped round the hot wire, the heat being transferred to the latter by conduction. The hot wire is only .13 mm in diameter, and the insulated wire does not absorb more than 1.5 watts for the full scale deflection. The Compagnie de Compteurs has introduced a novel temperature correction into its supply meters. The aluminum disk on the moving member of the instrument varies in resistivity considerably with temperature, and to compensate for this there is produced a proportional, but opposed, variation in the magnetic field. The magnet is provided with a magnetic shunt of a steel-nickel alloy whose permeability falls rapidly with increase in temperature, the material being practically non-magntic at 120 degs. C. If, therefore, the temperature of the instrument increases, the rise in the resistance of the aluminum disk is completely compensated for by the reduced amount of magnetic shunting which takes place owing to the fall is the permeability of the shunt.—Lond. *Elec. Engineer*, Sept. 13.

Testing of Series Motors.—An illustrated article on the commercial testing of series motors, describing four different methods, with particular reference to such motors which are controlled by resistance shunted across the series field coils.—Lond. *Elec. Review*, Sept. 20.

Telegraphy, Telephony and Signals.

Undamped Oscillations.—J. A. FLEMING.—An illustrated Physical Society paper describing experiments on the Poulsen arc as a means of obtaining continuous electric oscillations. The author describes various experiments which indicate strongly that the arc method of exciting undamped oscillations give rise to irregular groups of oscillations which are separated by short intervals of time. In order to be successful at all in producing high-frequency oscillations by the arc method he finds it essential to pay attention to a number of details. The carbon electrode should be kept in slow rotation. Hard arc carbons are better than soft ones. As regards the gas, pure hydrogen works with difficulty; coal gas is better, but cannot be used over and over again. The sides of the containing chamber must be kept cool, and the chamber must be cleaned out at intervals.—Lond. *Electrician*, Sept. 20.

Undamped Oscillations.—A note on a recent British patent of Poulsen. "In wireless telegraph or telephone systems where a continuous spark or arc discharge is used to produce the vibrations, the intensity of the vibrations is changed by varying the conditions of the hydrogenous atmosphere in which the discharge takes place. Ordinary illuminating gas may be used, and any ordinary device utilized for varying the amount of hydrogen in the atmosphere immediately surrounding the arc."—Lond. *Elec. Eng'ing*, Sept. 12.

Telephone Cables.—An article on extensions of the cable system of the British Post Office. They are continually laying additional underground cable, and a 118-wire cable has been laid beyond Watford, and may soon be extended to Aylesbury. This cable contains 28 pairs of 150-lb. conductors, 14 pairs 200-lb. conductors, and 34 single 70-lb. wires, screened with copper tape. The cable is not "loaded," but it is not unlikely that a loaded cable (of the Pupin type) may be employed when the next cable from Leeds to Newcastle is laid.—Lond. *Elec. Eng'ing*, Sept. 12.

BOOK REVIEWS.

THE PREVENTION OF ACCIDENTS. By F. W. Johnson. Second edition. New York: McGraw Publishing Company. 37 pages. Price, 25 cents.

The purpose of this pamphlet is to assist the management of street railway companies in the instruction and education of their carmen as to practical means of preventing the more common class of accidents, and as to procedure in case accidents occur which will assist electric railway companies in meeting fraudulent accident claims. The various heads include the accident report, witnesses to accidents, rear-end collision of cars, collision with teams, passing standing cars, stepping from moving cars, starting on one bell, railroad crossings, safe landing places, and open-car accidents.

ALTERNATEURS A COLLECTEUR. Monophases et Polyphases et les Dynamos a Courant Continu a Deux Paires de Balais. Par Charles Jacquin. Paris: Gauthier-Villars. 140 pages, 40 illustrations. Price, 3.50 francs.

The object of this little book is to review briefly the various classes of single-phase motors which have recently been brought forward. Mathematics have been avoided as far as possible, the object being to explain the mechanism and the principal features of their operation. Chapters treat respectively of the

direct single-phase commutator motor; compensating single-phase commutator motors; repulsion motors with two brushes and with several pairs of brushes; Latour single-phase motors with four brushes, with six brushes, and of a mixed type; the Arnold single-phase motor with three brushes; single-phase motors with fixed armature and moving brushes. One chapter is devoted to the Gorges-Latour-Heyland type of alternators, which was the subject of some discussion several years ago; and a final chapter has for its subject the Rosenburg and the Leitner-Lucas new types of dynamos. As will be seen from this recapitulation, the book deals with new types of apparatus, descriptions of most of which have not yet found their way into regular text-books or engineering treatises. Accounts which have appeared elsewhere of some of the machines described have been so involved with mathematics as to place the subjects beyond the reach of many readers, and to these the present book will be doubly welcome.

Standard Polyphase Apparatus and Systems. By Maurice A. Oudin, M. S. Fifth edition, revised and enlarged. New York: D. Van Nostrand Company. 369 pages; 207 illustrations. Price, $3.00.

That this treatise is now in its fifth edition indicates that it has met the need for a purely descriptive book on alternating-current machinery, devoid of mathematics and the discussion of points in design that appeal to the relatively few. Among the new matter is an extension of the notice of the single-phase motor, which, however, does not take full account of the present status of that branch. In fact, the book would have a greatly increased value if it did not adhere too closely to so-called "standard" apparatus, meaning the crystallized product of the larger manufacturing companies, but took account also of apparatus in course of development, and added some consideration of the latest forms of European apparatus, which of recent years has usually been in advance of American practice, and in many cases finally becomes "standard" in this country. The increased number of pages required by such an extension of the scope of the book would probably also have the incidental advantage of causing the substitution of book paper for the present glazed card board employed as such, the only object of which appears to be to give size to what would otherwise be a slim volume. These comments are not intended to impeach the high value which the book undeniably possesses within its present scope, nor reflect on the ability the author has shown in its compilation. In fact, it is the latter consideration that has prompted the wish that he might extend the work to a complete descriptive treatise on polyphase apparatus.

The Prepayment Watt-Hour Meter as an Aid in Securing New Business.

By H. W. Young.

To be convinced that the prepayment idea for the purchase of practically all forms of commodities is rapidly growing it is only necessary to consider the large number of automatic devices in use for vending practically all forms of commodities. Like the installment plan of payments, the prepayment meter appeals to a class of people who are accustomed to receive and spend their money in small quantities. The success of gas companies has been greatly aided and furthered by the prepayment meter, and its use in the electrical field should prove as great a success as it has proven in this field.

Prepayment meters are especially applicable in supplying energy to customers whose total consumption is relatively small and the collection of whose bills is a very considerable proportion of the total revenue derived. Their use greatly reduces the amount of bookkeeping and unavoidable monetary loss due to poor accounts, for the service is such that before securing light it is necessary that payment be made. This system, therefore, automatically collects its own bills, registers the actual consumption, and when the energy prepaid for is consumed, automatically disconnects the service. In installations such as flats, dormitories, barber shops, cafés, saloons, boot-blacking establishments, cigar stands, rented houses, or in any other installations where the volume of energy consumed is necessarily small, the prepayment meter will be found extremely useful. Central stations supplying towns having a large "floating" population, such as seashore resorts or college towns, where the rapid shifting of population renders difficult the following of accounts will find the prepayment meters extremely useful.

Another use for the prepayment meter is in the collection of old accounts. Central stations frequently have a considerable number of customers who are usually backward in payments, although they ultimately pay their bills. One method of forcing such customers to pay back bills is to threaten discontinuance of service, but this method is only resorted to as an extreme measure, owing to the resulting unpleasantness and very possible loss of a customer. On the other hand, a central station cannot afford to have its legitimate revenue tied up even with customers who will ultimately pay.

An effective way to collect these old bills, and at the same time continue the service, might be to install a prepayment meter adjusted for a higher rate per kw-hour than the regular rate. For instance, assuming the normal rate to be 10 cents per kw-hour, the meter may be set at 15 cents per kw-hour, so that the customer not only pays for the energy being consumed, but also gradually pays up the old bill on the installment plan. The majority of customers would undoubtedly prefer this method of paying up old bills to being forced by threats of discontinuance of service. After the account has been settled, the meter can be reset for the normal rate per kw-hour.

At the present time many central stations are unable to connect a considerable number of relatively small consumers, owing to the fact that the amount of energy used by each customer would be so small as to hardly justify the collection and accounting expense, which would be a very considerable percentage of the total receipts. For example, many station managers would hesitate to connect up consumers whose bills would probably not average over $1 per month, and, furthermore, these consumers do not understand and will not agree to a fixed minimum charge. However, assuming that the total revenue from such a consumer would average $12 per year, and assuming the cost of generation and distribution is one-half the gross receipts, it would leave a remainder or profit of $6, less the interest, collection and maintenance cost. While the gross profit would not be very large, yet the percentage is very satisfactory, and there is the additional advantage that a large majority of these new customers would gradually use larger amounts of energy and in time come within the class of desirable customers.

The use of electricity increases with the knowledge of its advantages, and there is no better way of introducing its use, especially with the smaller customers, than with the prepayment meter.

With the prepayment meter, differential rates can easily be made, owing to the fact that the rate per kw-hour is not shown on the meter bills and the central station may, therefore, place meters adjusted for different rates to meet the various conditions which arise; for instance, a long-hour consumer could be supplied through a meter adjusted at a lower rate than the short-hour consumer. This method of differential rates, though not in general use, is feasible for the reason that with a prepayment meter consumers feel they are purchasing light and not kw-hours.

Another use for the prepayment meter is in connection with electric cooking and heating appliances, which frequently are supplied with energy from a separate circuit at a different rate than is charged for lighting. These appliances may be supplied through a prepayment meter, and this system has the additional advantage of permitting the consumer to determine accurately just what the electric cooking or heating outfit is costing for the results obtained.

By preparing the meter for a definite amount, it can be used as a time switch to automatically turn off arc lamps, electric

signs and store window lighting. A case recently brought to the writer's attention illustrates quite forcibly another phase of the prepayment method of charge and its possibilities in settling disputes. A public hall largely used for lodge room purposes was electrically lighted and metered in the usual manner, the bill being equally divided between the several organizations using the hall. The secretary of one lodge claimed his bill for lighting was all out of proportion to what was actually used for the rather infrequent meetings, and this complaint was followed by that of another lodge secretary. The prepayment meter furnished a satisfactory solution of the problem, as each lodge was enabled to prepay the meter a sufficient amount for each evening session. Occasionally a case would arise where one lodge would have a small amount of energy to its credit, but as the load was comparatively constant and the approximate number of hours of burning known, the central station manager was in a position to instruct each secretary as to the amount of money to be deposited each evening, and in the long run these over-deposits would be compensated for by the small amount of prepaid energy left over by some other lodge.

Another case where the prepayment meter proved its worth was in a small town where gas competition was quite severe. Several small barber shops had both gas and electric service, but only used the latter when obliged to, such as, for instance, on hot nights when the patrons demanded it. The monthly consumption of electric energy would average only about $1.50, showing that it was used very sparingly, and upon investigation it was found that the several proprietors regarded the electric light as being too expensive. Prepayment meters were installed and within four months the revenue from these same places averaged from $5 to $6 a month. While the exact falling off in the gas bill was not ascertained, it must have been considerable, as the electric light soon became a necessity, rather than luxury.

Many forms of prepayment meters have been devised, and in Figs. 1 and 2 are illustrated one of the later types. The device consists of a regular single-phase measuring mechanism used in conjunction with a special register, automatic electric switching device and coin chute. The entire mechanism is mounted in a substantial cast-iron case, the cover of which is secured in position in a manner similar to that of the regular meter.

The operation of prepaying and using the meter is effected by dropping a quarter in the coin slot and turning the control drum to its maximum position toward the back of meter base, thus permitting the coin to enter the coin chute through which it drops into the coin receptacle. Insertion of additional coins repeats the operation up to a deposit of 10 coins, when the coin indicating pointer shows "full." If coins of a diameter less than that of a quarter are inserted, they will not pass down the coin chute or register on the coin wheel, owing to the action of a guide, which throws them into a by-pass through which they fall into the coin box without registering.

It will be noted that in addition to the regular set of dials as found in the ordinary meter, there is also a coin dial reading from 0 to 10 and also marked "full." The position of the coin index indicates the amount of money remaining to consumer's credit, the position of the regular dial showing the

FIG. 1.—GENERAL VIEW OF PREPAYMENT METER.

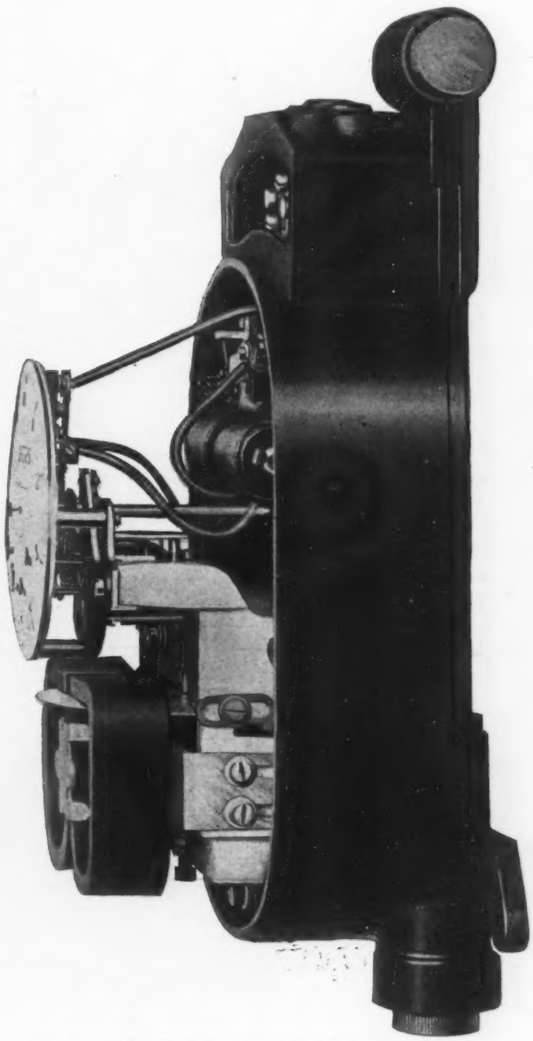


FIG. 2.—VIEW OF PREPAYMENT METER MECHANISM.

total amount of energy which has been consumed. Thus, while the coin indicator moves backward toward zero, the regular dials count up or integrate as in the standard meter. A constant check on energy consumed and money received can thus be maintained by comparing dial reading and cash receipts.

"Beating" or defrauding the operating company by tampering with the prepayment meter is extremely difficult owing to the fact that the coin chamber or receptacle is a part of the meter base, and in order to secure money it would be necessary to practically demolish the entire meter. The meter case is bug and dust proof, thus preventing the introduction of foreign material which would prevent or impair its registration. The scheme of tripping the coin wheel and switch by insertion of coins attached to wires or strings is prevented by the shearing operation of the coin drum, which would immediately cut the wire or string when turned to drop the coin into the chute.

The lock on coin receptacle is of "Corbin" make, is practically impossible to pick, and as every customer has his own combination and key number, no two stations having exactly the same lock and key, keys cannot be interchanged between employees of stations.

The Dynamo for Ignition Work.

By R. V. Sutliffe.

That the dynamo will ultimately replace all other methods of electrical generating for ignition purposes seems highly probable. The reasons which follow will, I trust, demonstrate that as a direct or indirect source of ignition energy, its place in the ignition field is assured. Pre-eminently, the dynamo as a generator is absolutely and permanently self contained and independent of outside asistance at any time. This means much in the long run for the isolated plant, motor-boat owner and commercial work generally.

Perhaps equally important is the fact that a dynamo may be readily designed to generate sufficient e. m. f. for ignition work while running at a speed of not over 1100 r. p. m. It is therefore possible in many cases to start the engine direct from the dynamo without the use of any batteries whatsoever, and thus all "upkeep" expense is permanently eliminated. Furthermore, as it is well understood, slow speed adds greatly to the life of bearings and moving parts and to the wear on the

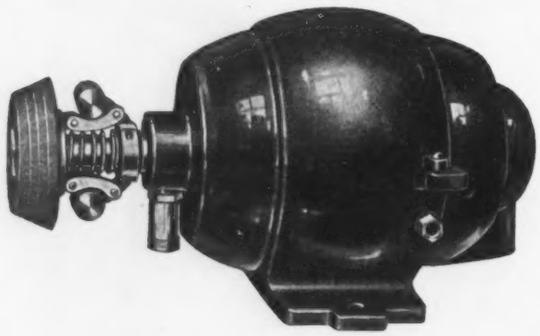


FIG. 1.—IGNITION DYNAMO.

brushes and commutator. The liability of insulated parts breaking down with a slow-speed generator is a remote one.

For touch-spark work the dynamo may be used directly connected through the coil to the engine, and this will be found the most satisfactory method of igniting, because of the higher voltage which it is possible to obtain before the circuit is closed and because of the extreme durability and reliability of a mechanical generator, as above stated.

Owing to the inherent conditions of a dynamo it is advisable for jump-spark work to supply the energy to the coils from a storage battery. Without the slightest doubt the energy from an accumulator is best suited for a vibrating jump-spark coil. Both the current and the e. m. f. are constant.

The dynamo is for all practical purposes the only method of keeping a storage battery in condition, and it will be found that one furnishing direct current at the proper voltage and amperage will be most satisfactory. Alternating current may only be employed in connection with a mercury arc rectifier and in a majority of cases direct current from an outside source is not available.

Under any light a generator especially designed for the work it has to do is most recommended and such an instrument may be directly connected to the battery to be charged without the

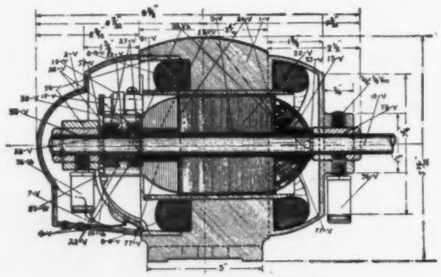


FIG. 2.—SECTIONAL VIEW OF IGNITION DYNAMO.

intervention of resistance material of any kind. Of course, it is well understood that a magneto will not charge a storage battery.

The writer has found a surprisingly large percentage of cases where a small dynamo of the type referred to above is directly connected to a jump-spark coil and used with absolutely satisfactory results, sometimes with interposition of a lamp or two in parallel with the circuit. The reason why this is not always commended is because of the fact that the condensers of some coils will not discharge against the inductance of the dynamo windings.

There has been some objection advanced against dynamos for ignition work, as it is claimed they cannot or have not been satisfactorily driven. The output of a dynamo varies almost directly as to its speed. It is therefore necessary on a variable speed engine to drive the dynamo with a speed governor, as a constant output is desirable. This can be and is accomplished in a number of successful ways, according to whether the dynamo is driven by belt, gear or friction. It takes but a trifle of power to actually drive the dynamo. Hence a very successful and reliable governor may be manufactured. The writer would state from personal observation that he has seen types of friction and belt drive governors which would maintain the speed of the dynamo constant within a variation of 15 r. p. m. regardless of the speed of the engine. Inasmuch as there are about forty thousand mechanical generators driven by frictional governors on the market to-day, I hardly see how this method is other than practical.

The dynamo for ignition work has been on the market over fourteen years. It has stood the test of time and of actual try-out in the field. Every indication points to the fact that the numerous advantages possessed by the dynamo over any other form of current generation for ignition work, both as regards efficiency, durability and economy, are such that it will eventually be universally employed for work of this nature.

Low Tension Magneto-Generator.

The General Electric Company has developed a low-tension magneto-generator for the ignition system of gasoline automobiles, the construction of which embodies several advantageous features.

Lubrication is effected by the use of waste packing in the same manner as has been successfully applied in connection with this company's automobile motors. Generous oil wells are provided with overflow holes to prevent excessive lubrication. The type of bearing used eliminates the small wick oiling device heretofore so often employed, and insures the ample lubrication necessary for these machines. The oil wells are readily accessible, and when covers are in place, are dust proof and

will operate for months without attention. Oil baffles are provided on both ends of the armature to prevent oil from working into the armature and interior parts of the magneto. Ample bearing surfaces are provided, as well as shaft of large diameter to insure strength, rigidity and a minimum amount of wear.

Both the base and the bearings are of bronze, which has been found a more satisfactory metal than aluminum for this use, as it is less fragile, much more durable and looks cleaner after extended use.

One end of the armature winding is brought out through the hollow shafting by means of a steel conductor. The insulation bushing between the shaft and this conductor is of bone, and it is, therefore, little affected by moisture or heat. The circuit from the steel conductor is completed by means of a phosphor-bronze spiral spring to the lever nut, which forms the outside

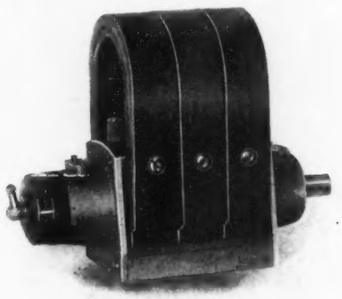


FIG. 1.—MAGNETO-GENERATOR ASSEMBLED.

terminal, thus avoiding any loose contacts. A hard-rubber cover screwed to the bearing carries the contact with all its parts. This cover is provided with a knurled exterior. The "grounded" side of the armature winding is firmly fastened to the core, and a carbon brush insures good contact between the armature winding and frame or ground.

The magnet cores are of the double type, sprung on the frame and secured by one screw on each side, thus minimizing the detrimental effect of drilling the cores. The long experience of the manufacturers in producing millions of permanent magnets for meters and instruments has materially assisted in the production of permanent magnets for these magnetos. The demagnetizing of the field magnets is prevented by avoiding a complete breakage of the permanent flux by allowing the armature core to overlap the pole-gap slightly when it is in a vertical position.

The design of the armature allows generous insulation and

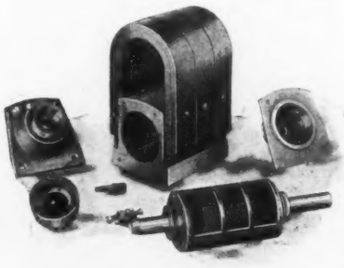


FIG. 2.—PARTS OF MAGNETO-GENERATOR.

also permits two other important advantages. With this magneto, an open circuit e. m. f. of over 100 volts is easily obtained, while a short-circuit current of approximately 0.4 ampere is available. In order to secure this high short-circuit current, the resistance of the armature winding is as low as possible, while the number of turns is sufficiently high to give an adequate open circuit voltage.

In introducing the magneto-generator at this time, after the season's large volume of business is passed, the company states that it is prepared to supply magneto-generators in large quantities, with a view of entering this part of the electrical business extensively during the next season. The above-described magneto-generator will be displayed at the various automobile exhibits this month and next in New York City and vicinity.

Universal Motor-Starter Panels.

The accompanying illustrations show a line of self-contained motor-starting rheostats, fuses and line switches which are designated as "universal panels" because they can be used to

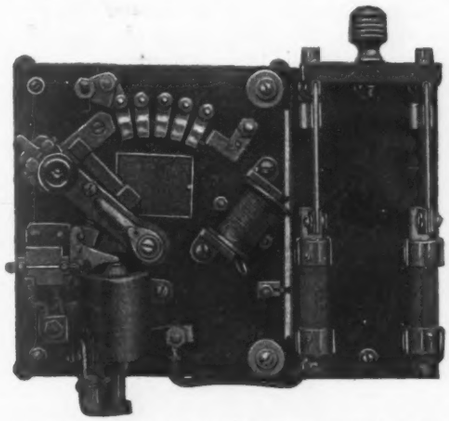


FIG. 1.—FRONT VIEW OF STARTER WITH OVERLOAD DEVICE.

start any known type of direct-current motor, whether series-connected, shunt-connected or variable-speed. Fig. 1 gives a front view and Fig. 2 a rear view of a universal motor-starter

FIG. 2.—REAR VIEW OF STARTER WITH OVERLOAD DEVICE.

equipped with independent interlocking overload circuit-breaker and no-voltage release. Fig. 3 shows a motor-starter equipped with a no-voltage release but without an overload circuit-

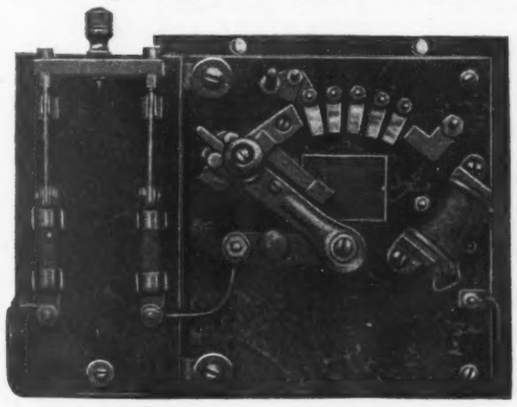


FIG. 3.—UNIVERSAL STARTER WITH NO-VOLTAGE RELEASE.

breaker. This starter is provided with a back-mounting plate, and the fuse arrangement is suitable for use where the load requires more than 25 amperes. For smaller loads, use is made of a porcelain-base combined switch and fuse.

On each of these starters the rheostat lever is provided with a separate renewable spring-actuated "flipper" switch connected to it by a flexible copper cable. In supplement to this there is provided an initial contact, which is a separate removable part readily renewable, and is so placed that no arc at this auxiliary contact can burn the stationary contact segments or the moving contact shoes. The spring flipper breaks the arc between it and the auxiliary initial contact by a quick snap action independent of the slowness of movement of the operator's hand. In the case of starters for motors rated at more than 10-hp the arc rupturing parts of the initial contact are provided with an efficient form of magnetic blowout device.

The above-described starters have been placed on the market by the Ward Leonard Electric Company, Bronxville, N. Y.

Porcelain Electric Signs.

The accompanying illustration shows a letter of a porcelain electric sign as manufactured by the Colonial Sign & Insulator Company, Akron, Ohio. The letters are concave and are of such form that they will reflect the light in parallel rays, thus enabling the sign to be read at a great distance and at any angle. No paint is used on the letters; they are made of vitrified porcelain, with a permanent and beautiful glaze, and they will withstand all conditions of heat and weather.

PORCELAIN SIGN LETTER.

The above-described porcelain electric sign letters have been approved by the Board of Fire Unerwriters.

Iron-clad Portable Instruments.

The General Electric Company, Schenectady, N. Y., is now introducing a new line of iron-clad portable instruments. The voltmeters and wattmeters are constructed on the direct reading dynamometer principle, while in the ammeters the Thomson inclined coil principle is applied. Mechanically these instruments are substantial in construction, with light-weight moving element, not susceptible to injury in transportation. The coils of these "Type P-3" instruments are entirely surrounded by a laminated iron shield which protects thoroughly from the influence of external magnetic fields. One of the severest tests of the reliability of these instruments when used for laboratory or general testing purposes is their ability to give accurate indications when used in the vicinity of external magnetic fields.

The instruments excel in mechanical construction, are neat in appearance and very substantial. They are contained in wooden carrying cases provided with hinged cover and snap lock. By the removal of the internal moulded cover and three screws, the entire mechanism can be taken from the case. The binding posts are brought out at the top of the instrument and are provided with suitable thumb screws for securing the leads which connect the instrument to external circuit.

The instruments may be used on circuits of any frequency, wave form or power factor without appreciable error. The voltmeter and wattmeter may be used interchangeably on direct or alternating current. The ammeter, although primarily an alternating-current instrument, may also be used on direct-current circuits by taking reverse readings. The scales subtend an arc of approximately 90 deg. and are very legible, as may be noted by reference to the accompanying illustration.

Careful attention has been given to the construction of the jewels and pivots, as these have great influence upon the continued accuracy of indicating instruments. The pivots are made from the best grade of steel, specially hardened and highly polished, and are suspended in high grade sapphire jewels which are practically indestructible. The pointer fluctuations are damped by means of Foucault currents set up in a thin aluminum segment attached to the shaft, and it oscillates with each movement of the pointer in the field of two statistically arranged permanent magnets. The weight of this segment balances the weight of the pointer, thereby maintaining equilibrium without extra counter weights.

FIG. 1.—INSTRUMENT COMPLETE.

FIG. 2.—DETAIL VIEW OF INSTRUMENT.

The ammeters are made self-contained in ratings up to and including 30 amperes; the voltmeters up to and including 750 volts, and single-phase wattmeters in ratings up to and including 30 amperes and 750 volts.

Exhibits at the New York Electrical Show.

We described in last week's issue, the exhibits made by the various electric light companies at the Electrical Show which closed on Oct. 9, in Madison Square Garden, New York City. None the less interesting were the displays made by manufacturers of electrical apparatus, dealers and contractors, brief descriptions of whose exhibits follow.

THE WESTINGHOUSE COMPANIES occupied a space of about 2000 sq. ft.; the exhibit, quite an extensive one, was perhaps the most varied of any at the show. Approximately 20 applications of electric motors were shown, including ironing machines for the home and for laundries; pipe threading machinery, showing the most compact arrangement with this sort of work that has yet been made possible, the same being operated by means of a motor, rheostat, switches and wiring all on one bed; a blower for ventilating mines, subways, etc.; vacuum cleaner, made by the Sanitary Devices Mfg. Company, for the renovation of houses, hotels, etc.; exhaust fan made by the American Blower Company, for ventilating purposes; the Watson-Stillman pump for raising water to small house tanks for summer residences, hotels, etc.; a rotary air compressor for the operation of compressed-air tools, inflation of automobile tires, etc.; Yale & Towne hoist for factory uses; dish washing machinery, for cleaning dishes in the home and in hotels and restaurants; Singer sewing machine for domestic purposes; textile loom, operated to show the manner in which fabrics are woven; dough mixer, showing the manner of mixing dough in the home and in bakeries, and last, but perhaps most interesting to the commercial man, the phonograph in conjunction with the shaver. All of this apparatus was driven by Westinghouse motors, and experts explained the operation of the machinery. In the same space the Westinghouse Lamp Company gave demonstrations of incandescent lamp manufacturing, showing the different processes through which an electrical lamp passes before it is ready for use. The Westinghouse Electric & Manufacturing Company showed a full line of its arc lamps for all currents and voltages, as well as a complete set of its measuring instruments. Fan motors for all circuits were shown as well as transformers of various types and sizes. The space was attractively lighted with Nernst lamps mounted on columns. Cooper-Hewitt mercury vapor lamps were also exhibited from the ceiling of the Garden, demonstrating the value of this lamp for the lighting of large areas, such as shops, factories, train sheds, wharfs, etc. The Westinghouse Machine Company showed storage batteries for central-station work and also sparking batteries for automobiles. A 15-hp motor was shown in the exhibit, operating under load on a 220-volt, direct-current circuit, and attached to this machine was a speed-indicating device. It may be interesting to note that apparatus manufactured by five of the Westinghouse Companies was on exhibition.

THE GENERAL ELECTRIC COMPANY'S exhibit was planned with a view to interesting the general public with appliances that appeal most directly to it. Never before has a manufacturer's exhibit been so complete in both the motor and heating applications for household or culinary purposes. The company occupied eight booths on the left of the main aisle in the center of the Garden. The exhibit was laid out with a main booth roofed with an arched canopy forming a galaxy of light and two open wings on each end. The front wing was devoted to the motor household and culinary applications and electric ironing. The visitor could demonstrate personally the advantages of the electric-driven sewing machine, potato peeler, the ice cream freezer, and observe the clothes both washed and ironed. Of particular interest was the electric carpet renovator in which a motor drives a cylindrical brush and a centrifugal fan which produces a suction at the brush and delivers the dust into a receptacle. There were also on exhibit in this wing, motor-driven dough mixers, coffee grinders and meat choppers. To heighten the interest in this wing a moving picture machine illustrated graphically the exciting race between the General Electric Company's electric locomotive and a New York Central flyer running 70 miles per hour. There was also an electrically operated Regina music box. The main booth was devoted to a model dining room and a model kitchen. The former was furnished in mission. Over the table hung an ornate shell dome in which was a 40-cp tantalum meridian lamp. The electric cigar lighter and the corn popper on the table were suggestive dining-room conveniences; the electrically wired side table on which were an electric chafing dish and percolator indicated the best way to provide for these modern necessities. The electric fan was not omitted. In the model kitchen were electric kitchen cabinets, large and small size, in which busy demonstrators prepared biscuits, fudge, rarebits and other delicacies A counter along the side was stocked with a complete assortment of electric heating and cooking appliances, many in operation, for examination by the curious and interested. The end wing was devoted to industrial applications. Attracting considerable attention, partly on account of its noise, was an Ingersoll-Temple rock drill in operation. A 3-hp motor drove an air compressor and pulsator, the energy being transmitted to the drill through the medium of compressed air. It is a machine which combines both the advantages of the pneumatic and purely electrical drills. A 1-hp motor was also shown driving a cabinet-maker's circular mitre saw. A mercury arc rectifier automobile charging set, which was shown in operation, with switchboard equipment attracted much attention. Of special interest was a 30-kw, four-cylinder, direct-connected gasoline generator set which the General Electric Company is just placing on the market. A new electrically driven floor

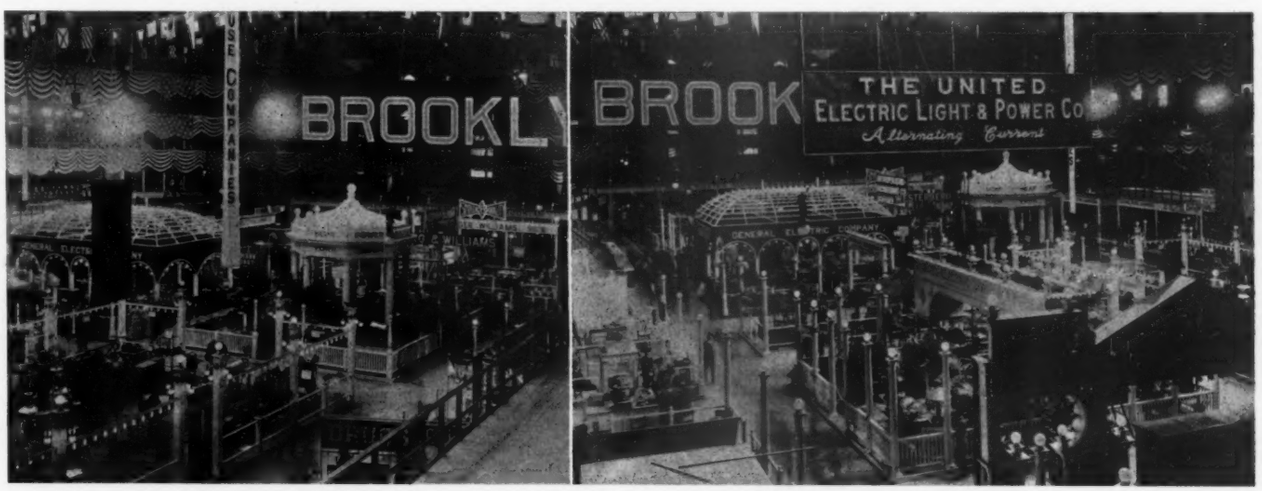


FIG 1.—GENERAL VIEWS OF THE EXHIBITS AT THE NEW YORK ELECTRICAL SHOW.

sander in which a 2-hp motor drives a 15-in. sanding drum, was in use for demonstrating. A 20-kw Curtis turbine steam generator set used for train lighting and a disassembled turbine showing the advantages of construction; also a Bridgeport double 12-in. emery planer driven by a 2-hp induction motor and numerous small motors for various applications completed the exhibit in this wing.

On the left side of the main booth, a color booth of four sections was placed, and each section was lighted by a standard illuminant, viz., enclosed arc lamp, Welsbach gas lamp, incandescent lamp and Nernst lamp, for the purpose of illustrating the effect of artificial illuminants on colors.

The F. Alexander Electrical Company, New York City, showed a number of 3-ampere miniature arc lamps. These lamps are said to give 500 candle-power.

A. Grothwell, New York City, exhibited the Mogul electrical compound, Mogul armature varnish, and Mogul acid and alkali proof compound, together with paints and varnishes for various power house applications.

The Federal Sign System Company, New York City, made a handsome display of the various types of Federal signs, as well as samples of large cut-out letters for roof sign work. The porcelain enamel stencil unit letters and interchangeable panel signs were a feature of the exhibit.

The Excello Arc Lamp Company, New York City, exhibited a number of its "Sun Ray" lamps in its booth on the north side of the arena. Four of these lamps were suspended in the tower of the Garden, and a number of "Sun Ray" and "Pearl White" lamps were used in many booths. In the booth of the company the mechanism of the different types of lamps were shown in detail, as well as a number of photographs showing installations at home and abroad.

The National Electric Lamp Association had a most up-to-date exhibit. At its booth, which was illuminated almost as though by daylight, were to be seen lamps with the following filaments: Cellulose, Gem metalized, tantalum and tungsten, each lamp in turn being more efficient than its predecessor. The clear white penetrating light from the last two named lamps was quite marked. A type of tungsten lamp in which the filament is arranged so that the lamp may be burned horizontally was shown.

The Garvin Machine Company, New York City, exhibited a number of motor-driven machine tools. These included a universal milling machine operated by a variable-speed motor, two plain milling machines similarly operated, and a milling machine with an automatic slot-milling attachment. There were also shown a radial drill operated by a constant-speed motor, an automatic tapping machine operated by a variable-speed motor, and a die-slotting machine operated by a constant-speed motor.

The Metropolitan Engineering Company, New York City, displayed its various types of signs, including roof signs, overhanging signs, panel signs, and sign fixtures. The company drew attention to the fact that it built the large sign used by the Edison Electric Illuminating Company, Brooklyn, and also the sign used by the United Electric Light & Power Company at the show. The large signs on the Madison Square Garden tower were also made by this company, whose product is so well known as to need no further comment.

The Consolidated Telegraph & Electrical Subway Company, New York City, showed a full-sized brick and concrete manhole, together with the connections from the manhole to the distribution box and to the standard street arc lamp as used in New York. The methods of running the cables in the conduit, splicing, tapping, and also of draining the manhole were clearly shown. The manhole was built from the floor up and illuminated within so that the method of supporting the cables on the cable-racks within the manhole, and also the method of making splices were plainly visible.

The Beck Flaming Lamp Company, New York City, has six of its flaming arc lamps illuminating the exterior of the Garden during the Electrical Show, and in addition, the company showed a 12,000-cp arc lamp, which was installed on the corner of Madison Avenue and Twenty-Sixth Street. The lamp was suspended about 50 ft. above the street level and illuminated a large section of Madison Square. A number of the company's lamps was strung along the north side of the arena; and in its booth the company demonstrated a complete line of lamps, including series and multiple alternating-current types, and the series and multiple direct-current types. In the booth of this company the H. C. K. Company also showed a full line of portables and fixtures.

The Driver Harris Wire Company of Harrison, N. J., manufacturers of resistance wires, illustrated a few of the many applications of resistance wire to electrical appliances. Among the new and novel uses may be mentioned an instantaneous hot water heater in which the water passes through a coil of electrically heated "Advance" resistance wire; a branding iron in which the metal stamp is kept at red heat continually, and a sad iron. Among other appliances shown were portable cab heaters, arc lamp resistances, stereopticon rheostats, cooking utensils, measuring instruments, theater dimmers, resistance units and a new type of motor starter, which is said to be absolutely flame proof in case of a burn-out and contains a resistance wire of negligible temperature coefficient. A representative line of "Advance" and "Climax" resistance wires, both bare and insulated, were exhibited.

The Electrical Testing Laboratories, New York City, displayed a complete line of standard apparatus for making tests for resistance, e. m. f. capacity, inductance, etc. Two special test tables arranged with voltmeter, ammeter and wattmeter, and provided with the necessary rheostats, main switches, reverse

FIG. 2.—EXHIBITS IN CENTER OF ARENA.

switches, instruments and potentiometer, were shown in actual use testing instruments during the exhibition, energy being supplied by 140 small storage cells and two large storage cells. An oscillograph was shown in operation, one curve showing the e. m. f. wave of a small rotary converter, another curve giving the form of the current wave produced by the converter in an inductance coil, and the third, the form of the charging current curve of a condenser connected with the same circuit. The positions of these curves displayed to the eye the phase relations between the e. m. f. and the currents in the inductance coil and the condenser. The harmonics of the e. m. f. wave were exaggerated in the condenser curve, this latter curve having a large number of saw-tooth peaks. A photometer for incandescent lamps was exhibited, as well as an improved type of industrial photometer extensively used for measuring the candle-power and watts per candle-power of incandescent lamps. A spectrophotometer and a Weber photometer used for measuring illumination were also on exhibition. A stroboscope was shown in connection with the alternating-current arc. The instrument consists of a disc mounted on the shaft of a single-phase induction motor, which is fed from the generator supplying the energy to the arc lamp. The disc has a radial slot for each pole of the motor. By means of a lens an image is projected so that the light passes through the slots of the disc. The motor runs at a point near synchronism, the slip being sufficient to cause the image to go through its alternations on the screen at the rate of about two cycles per second. The screen was in plain view of the visitors and attracted no little attention.

The Amboy Works, Perth Amboy, N. J., had a very beautiful display of art glass globes and shades.

The Monaton Construction Company, Brooklyn, N. Y., contented itself with showing engineering plans.

The Standard Roller Bearing Company, Philadelphia, Pa., made a very interesting exhibit of its various types of roller bearings.

The American Wire Brush Company, New York City, showed a complete line of wire brushes for cleaning conduits, boilers, flues, chimneys, tracks, surfaces, pipes, etc.

The American Marconi Wireless Telegraph Company had a station at each end of the Garden and demonstrated the method of sending and receiving wireless messages.

The Advertising Mirrorgraph Company, Brooklyn, N. Y., exhibited its mirror signs, advertising signs and single lamp letters, together with its flashers and "thermoblinks."

The Morelite Company, New York City, demonstrated the "Just" tungsten lamp in its booth in the northwest corner of the Garden. The lamps were shown operating side by side with the ordinary carbon filament lamp.

The India Rubber & Gutta Percha Insulating Company, New York, had on exhibition a full line of Habirshaw wire, cables and cores, together with material for high-tension transmission, and underground and submarine work.

Westerberg & Williams, engineering contractors, New York City, exhibited some very interesting motor-driven apparatus. A refrigerating plant producing 800 lbs. of ice per day was shown in operation, as well as a float-controlled centrifugal pump, a vertical pump, ice cream freezer and refrigerator.

The National Dairy Supply Company, New York City showed the Burrell-Lawrence-Kennedy cow-milker in operation. The apparatus operates by means of partial vacuum and is said to give satisfaction. A number of cows were milked at stated intervals for the edification of a large crowd of sight-seers.

The Baker Motor Vehicle Company, New York, exhibited an electric automobile, driven by a 2½-hp motor and provided with a battery giving the vehicle a range of about 75 miles on a single charge. The method of charging the battery from the Edison mains was clearly shown.

G. M. Gest, New York City, displayed typical views of conduit installations and also his well-known cable-rack. The H. B. Camp Company also showed in this booth samples of its single and multiple duct conduit; and the Fiber Conduit Company exhibited sections and full lengths of conduit in both its untreated and treated state.

The Kenny Electrical Manufacturing Company, New York City, had on exhibition a motor-driven printing press, the feature of which is that it may be stopped instantly by a movement of the foot-treadle, without working on the rheostat. The Kenny system of friction drive was also shown. A motor-driven drill saw, a circular saw, and a hack saw formed part of the exhibit.

The Safety Car Heating & Lighting Company, New York City, showed its axle-driven car lighting system, mounted on a full-sized railroad car truck, such as is used by the Pullman Company. The generator had a rating of 80 amperes at 50 volts, and the system shown included the regulating apparatus and connections. The company also had on exhibition various lighting and heating fixtures used in connection with its system.

The W. Green Electric Company, New York City, displayed a very interesting line of small motor-driven tools for dental, household and light manufacturing work. The polishing and grinding motors have a double-end connection and are provided with a rheostat in the base so that the whole machine is self-contained. An alternating-current machine, with a friction drive and provided with an automatic oiling arrangement and a special jeweler's lathe attracted much attention.

The Simplex Electric Heating Company, through Roger Williams, its New York representative, made a very elaborate exhibit of electric heating and cooking devices. In fact, this was one of the most complete exhibits of heating devices ever made. In the booth were a corps of demonstrators explaining the working of the various devices. A new type of range, the feature of which is that it does away with the angle-iron frame and the slate back board for connections, was shown. The oven of this range is made to serve as a base for the top of the stove and has an iron framework. All connections are brought through the face plate above the oven, and there are no cord circuits in the way to be covered with grease, etc. Four-way snap switches located on a slate base on the front of the range control the connections. A patented method of clamping the cooking utensil against the heating surface was also shown. This results in a more effective heat transmission between the heater and the cooking utensil.

Open Sale of Bell Telephones.

Some years ago, immediately after the expiration of the earliest Bell telephone patents, the American Bell Telephone Company, whose instruments had theretofore been placed only in the hands of licensee companies, and not sold, began the sale of telephones "across the counter" to the general public. This did not continue very long, however, and the practice was dropped as suddenly as it had begun, and without any explanation. It is now announced that the Western Electric Company, which is largely owned by the American Telephone & Telegraph Company, and which makes the Bell telephone apparatus, will sell its telephones and telephone supplies to all buyers.

President Theodore N. Vail, of the American Telephone & Telegraph Company, has confirmed the report. He explained that the idea had been under consideration for a long time, but that heretofore one difficulty had been that the Western Electric Company needed more plant, its full energies being required to supply the demands of the Bell companies alone. This obstacle to doing a general business has been overcome by the recent completion of very large additions to the Chicago factory of the Western Electric Company, and hence it is now in a position to take care of outside orders.

In reply to a question as to the probable effect of this action on the revenues of the American Telephone & Telegraph Company, Mr. Vail said that no considerable direct increase was anticipated but that a great indirect advantage was looked for from improved relations between the public and all of the associated Bell companies, because there has been an entirely erroneous idea more or less prevalent, that the charges of these companies for their services were based on a monopoly of telephone instruments, while the fact is that the instrument is but a small part of the plant required in giving telephone service. It is felt that this action may cause it to be more clearly understood by the public that the Bell companies' only claim for patronage is based on their ability to furnish the best service at reasonable prices and not on any instrument monopoly.

Mr. Vail aserted that at the present time many inefficient telephone instruments are in use on local and private lines and that the Bell companies desire to see these replaced by standard instruments in order that it may make traffic connections with the greatest possible number of properly equipped lines, assuring proper service and transmission. For example, there are thousands of so-called "Farmers' lines" which will furnish valuable feeders for the toll lines of the larger system when properly equipped and maintained. This situation can be provided for through the sale outright of Bell instruments and apparatus.

In answer to the question as to whether it was intended that the Western Electric Company should become an aggressive competitor of the independent manufacturers who, up to this time, have had a monopoly of the selling trade, the only reply was that the Bell interests were fully prepared, either from the manufacturing or operating side of the business, to meet all the needs of the public, and that they wished to demonstrate that they claimed or asked no advantages other than their ability to meet those needs under square competitive conditions of quality and price.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Reports from the various trade centers were somewhat uncertain in tone, but not without a tendency to optimism. Interest in fall trade was active, and results in this direction are all that could be desired. There is no sectional difference on this point, all leading cities reporting a liberal distribution of seasonable wearing apparel. Among the manufacturers the most notable increase in orders is reported by New England shoe shops, while there is no idleness at cotton mills, and the reduction of steel output is not significant. Crop news of the week was encouraging, all the great staples except corn and cotton being beyond danger from frost, and another week will secure the former crop, with its farm value of approximately $1,250,000,000, while there is little fear of killing frost in the cotton states this month. Railway earnings thus far reported for September exceeded the figures for 1906 by 7.6 per cent, and foreign commerce at the port of New York showed a gain of $4,485,363 in exports and a loss of $1,831,165 in imports. Collections, while still dragging, in consonance with the tightness in money, appear to have improved at a number of centers. Many industrial lines are less active on new business, and working forces in such lines as iron, steel, car manufacturing, electrical goods, shoe manufacturing and copper mining are being reduced. Lumber is less active, and new building is lighter, due in part to the approach of the closed season, but more particularly to the stringency in money. Pig iron continued very dull, foundry grades being weaker. On the other hand, Bessemer pig iron was firm and scarce in the Central West. Demand for structural material was good. Competition for fabricated work is more active, and as a result the price situation is easier. Domestic orders for steel rails are light, but a contract for 12,000 tons has been taken for the Manchurian railroads, with an additional 70,000 tons still under negotiation. Copper is again lower, lake brands for future delivery being quoted at 14⅛ to 14½ cents and electrolytic at 14 to 14⅛ cents. At the lower levels foreign demands developed somewhat, but domestic trade is still of a hand-to-mouth character. The leading interests curtailed production considerably in September, but it is reckoned that the actual decrease was not very marked, owing to the decreased outputs of other mines. Failures for nine months are only slightly more numerous than a year ago, but liabilities, swelled by a number of large suspensions, are considerably heavier. There were 6891 failures reported to *Bradstreet's* for nine months, with liabilities of $111,238,064, an increase of only a fraction of 1 per cent in the number, but of 25 per cent in the liabilities, as compared with last year. The proportion of assets to liabilities for nine months is 55.1 per cent, the highest proportion noted since 1897, indicating a larger number of failures of usually solvent concerns. The number of failures during the week ending Oct. 3 was 177, against 166 in the week previous, and 136 in the corresponding week last year.

AMERICAN RAILROADS.—The advance report of the Interstate Commerce Commission gives figures of the steam railroads of the United States for the year ending June 30, 1906. The total single-track mileage was 224.363 miles, with 51,672 locomotives and 1,958,912 cars of all classes and 1,521,355 persons on the payroll. The number of passengers carried was 799,507,838. The passenger mileage, or the number of passengers carried one mile, was 25,175,480,383, the increase being 1,375,330,947 passenger miles. The number of tons of freight shown as carried (including freight received from connections) was 1,631,374,219, which exceeds the tonnage of the year 1905 by 203,642,314 tons. The ton-mileage, or the number of tons carried one mile, was 215,877,551,241, the increase being 29,414,441,731 ton-miles. The number of tons carried one mile per mile of line was 982,401, indicating an increase in the density of freight traffic of 121,005 ton-miles per mile of line. The average revenue per passenger per mile for the year ending June 30, 1906, was 2.002 cents. The total capitalization was $14,570,421,478, or $67,936 per mile. Of this, $6,803,760,093 was stock, 33.46 per cent of which paid no dividends. The gross earnings were $2,325,765,167. The total income was $1,045,527,487, and the net, after charges, $385,186,328, out of which $272,851,567 was paid in dividends.

LUSITANIA TELEPHONES.—The new turbine-driven monster, *Lusitania,* of the Cunard Steamship Company, has been equipped with a telephone system, the most extensive in use on any vessel. The National Telephone Company installed the equipment and will supply the sister steamer, *Mauretania,* with another like it. The installation on the *Lusitania* consists of eighty-nine stations and ten exchange lines connected to a switchboard having equipment for 200 stations and twenty exchange lines. The telephone instruments are installed in the regal first-class staterooms, in the cabins of the ship's physician, purser and chief steward and in the bureau. When the boats are in port the exchanges are connected for local and long-distance service with the city systems.

WESTINGHOUSE SHOPS.—Advices from Pittsburg state that the new eight-story factory building of the Westinghouse Electric & Manufacturing Co. at East Pittsburg is completed. The tools and machinery have nearly all been set up and the removal of the employes into the structure will begin at once. The readjustment in its operating force at the East Pittsburg Works will mean a saving of approximately $1,000,000 a year in operating expenses, according to a statement of the company. During the last two years, the management has been making a large number of improvements. New and improved machinery has been installed in various departments, which has greatly enhanced the productive efficiency of these branches of the plant, at a reduction of actual labor.

SOUTHERN PACIFIC ORDERS.—The Southern Pacific Railroad has just ordered two 5000-kw turbo-generators to be built by the Westinghouse Company for the electric power plant that is to be erected at the foot of Fruitvale Avenue on the Oakland estuary. These generators will be 13,200 volts, 25 cycles, three-phase. They will cost close to $250,000. In addition to these generators, and the already ordered boilers, the company has placed Eastern orders for the construction of about 90 electric passenger cars, somewhat like, but longer than the Key Route cars. These will be used on the Alameda and the Oakland suburban systems, diverging from both the Oakland shore piers.

SOUTH EAST AFRICA.—An American business man contemplates returning to Southeast Africa in the interest of his concern, which makes rock drills, and states to the Bureau of Manufactures that he desires to represent other manufacturers for the sale of goods in the territory from Lourenço Marquez to Mombasa and Zanzibar. He suggests as among the salable lines, mining and electrical machinery.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was dull and heavy with considerable bearish activity. High money rates discouraged buying, and most of the week's incidents, including the reduction in the Anaconda dividend, the receivership of the Metropolitan Street Railway, and the talk of further governmental action against railroads, resulting in an unsettled tone. New York Central was unfavorably affected by the report that it was negotiating a $50,000,000 loan abroad. Brooklyn Rapid Transit showed a tendency to improve in the face of the weakness in the other tractions, the talk being that its forthcoming annual report will be a very favorable document. One of the objects of bearish attacks was the United States Steel issues, especially the common, this movement being based on further rumors of reduced demands and orders for steel. In the latter part of the week a number of low-priced stocks were taken in hand by the bears and yielded rather sharply, some of them touching the lowest prices they have reached in a long time. Brooklyn Rapid Transit ranged between 42½ and 48½, and closed the week at 46¾, this being a net gain of 4 points. Metropolitan Street Railway dropped 2¼ points. No marked movements occurred in the electric

list, with the exception of Westinghouse, which closed with a net loss of 9 points, the last quotation being 129. The curb market was professional, with an absence of public participation. The closing quotations of Oct. 8 are given in the accompanying table.

NEW YORK.

	Oct. 1	Oct. 8		Oct. 1	Oct. 8
Allis-Chalmers Co.	7⅜	7	General Electric 123		122
Allis-Chalmers pfd.....	21½	19½	Hudson River Tel.....	—	—
Am. Dist. Tel.....	20	—	Interborough Met. com.	8¼	9¼
American Locomotive...	51⅜	50½	Interborough Met. pfd..	23	24½
Amer. Locomotive pfd..	99½	99¼	Mackay Cos.	60¾	59¼
American Tel. & Cable..	75	75	Mackay Cos. pfd.....	61	58½
American Tel. & Tel...105		104	Marconi Tel.	—	—
Brooklyn Rapid Transit.	47	45⅜	Metropolitan St. Ry....	36	35
Electric Boat	—	—	N. Y. & N. J. Tel.....100		99
Electric Boat pfd.....	—	—	Western Union Tel....:	72	72
Electric Vehicle	—	—	Westinghouse com. 120		115
Electric Vehicle pfd...	—	—	Westinghouse pfd. 165		165*

BOSTON.

	Oct. 1	Oct. 8		Oct. 1	Oct. 8
American Tel. & Tel...105¾		105	Mass. Elec. Ry. pfd...	47¾	47½
Cumberland Telephone..	—	—	Mexican Telephone.....	2	—
Edison Elec. Illum.....206		—	New England Telep....141½		—
General Electric 124¼		125	Western Tel. & Tel.....	—	—
Mass. Elec. Ry.....	—	—	West. Tel. & Tel. pfd...	—	—

PHILADELPHIA.

	Oct. 1	Oct. 8		Oct. 1	Oct. 8
American Railways.....	46¾	46½	Phila. Electric	7½	7½
Elec. Co. of America...	8⅞	8⅞	Phila. Rapid Transit....	19	19½
Elec. Storage Battery..	44	42	Phila. Traction	86¾	87
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	Oct. 1	Oct. 8		Oct. 1	Oct. 8
Chicago City Ry.....150		150	National Carbon	—	—
Chicago Edison	—	—	National Carbon pfd...	—	—
Chicago Subway	—	—	Union Traction	—	—
Chicago Tel. Co.....	—	—	Union Traction pfd....	—	—
Metropolitan Elec. com.	19	19			

*Asked.

DIVIDENDS.—The Philadelphia Company, of Pittsburg, has declared a regular quarterly dividend of 1½ per cent on the common stock, payable Nov. 1. The directors of the Boston Suburban Electric Company have declared a regular quarterly dividend of 75 cents on the preferred stock, payable Oct. 15. Directors of the Public Service Corporation of New Jersey have declared the regular quarterly dividend of 1 per cent. Directors of the Mexican Telegraph Company have declared the regular quarterly dividend of 2½ per cent, payable Oct. 16. Directors of the Shawinigan Water & Power Company have declared an initial dividend of 1 per cent on the common stock for the quarter ended Sept. 30. Directors of Chicago Pneumatic Tool Company have declared a regular quarterly dividend of 1 per cent, payable Oct. 25. National Carbon directors have declared the regular quarterly dividend of 1 per cent on the common stock, payable Oct. 15. Directors of the Cuyahoga Telephone Company have declared the regular quarterly dividends of 1½ per cent on the preferred stock, payable Oct. 30, and 1 per cent on the common stock, payable Oct. 21. Directors of the U. S. Telephone Company have declared the regular quarterly dividends of 1½ per cent on the preferred stock, payable Oct. 15, and ¾ of 1 per cent on the common stock, payable Oct. 25. Directors of the New York & New Jersey Telephone Company have declared the regular quarterly dividend of 1¾ per cent, payable Oct. 15. Directors of the Cincinnati, Newport & Covington Light & Traction Co. have declared the regular quarterly dividends of 1⅛ per cent on the preferred and ¾ per cent on the common stock, payable Oct. 15.

THE MACKAY SYSTEM, now that the New York-Havana cable has just been laid, has a total of 25,000 miles of submarine cable operated by its two subsidiary companies, the Commercial Cable Company and the Commercial Pacific Cable Company. The new cable line, which has cost between $1,400,000 and $1,500,000, has been paid for entirely out of earnings. Of the 25,000 miles of submarine cables, approximately 16,000 miles are operated in the Atlantic Ocean by the Commercial Cable Company and 9000 miles in the Pacific Ocean by the Commercial Pacific Company. The company figures the cost of cable construction at $1,000 per mile, which would represent a property investment in the entire cable system of fully $25,000,000. The Commercial Cable Company is now operating five trans-Atlantic cable lines which are crowded to their utmost capacity. It seems likely that the company will undertake within another year the laying of a sixth Atlantic cable. For operating purposes the officials of the Mackay Companies look upon their land lines, represented by the Postal Telegraph Company and the cable lines in the Atlantic and Pacific as one system. For this reason in pursuing development work it has come to be the policy of the management, when an unusual amount of money is spent in one year on either the cable or land lines in extensions, to expend less during that year on the other and during the following year reverse the course of expenditures. This year telegraph construction on land has been cut down very materially and surplus earnings in part diverted to the payment of the Cuban cable.

B. R. T. ANNUAL.—The Brooklyn Rapid Transit annual report shows that there were carried 511,839,437 passengers, an increase of 59,235,234, or 13.1 per cent over the previous fiscal year. The average gross earnings per passenger are 3.60 cents, as compared with 3.89 cents for the preceding year, a loss per passenger of 7.5 per cent. The average net earnings per passenger, with no deductions for special appropriations or fixed charges are 1.48 cents, as compared with 1.70 cents for the previous year. The statement of earnings shows gross of $19,381,587, compared with $18,473,328 the previous year. The operating expenses totaled $11,465,705, against $10,441,377 in 1906, and the net earnings amounted to $7,915,882, compared with $8,031,951 the previous year. The balance sheet disclosed loans and bills payable o $900,000 and cash on hand $965,670, compared with $2,001,559 the year before. The surplus stood on June 30 last at $3,734,006. On June 30, 1906, the surplus was $2,075,563. On the subject of taxation President Winter says that it has been the disposition of the public to levy every possible tax against corporations holding public franchises. He regards this as short-sighted, and says that every million dollars of excessive taxes would pay interest at 5 per cent n $20,000,000 invested in extensions or enlargement of transportation facilities.

THE CONOWINGO ELECTRIC COMPANY, with charter rights to dam the Susquehanna River at Conowingo, 8 miles from Havre de Grace, is getting ready to build a new power plant with 100,000-hp capacity, rivaling the great McCall's Ferry power plant. The object is to deliver power to Baltimore, Philadelphia, Wilmington and New York City. Men are at work converting the old boarding house of the Conowingo Paper Company into shape so as to facilitate accommodations for hundreds of persons to be employed. It is proposed to construct the power house on the Hartford County side of the river, the same as the York Haven Water & Power Company's plant, and make the dam about the same height as the McCall's Ferry dam and back the water as far as Peachbottom, a few miles below McCall's Ferry. If this is the case, the Susquehanna River from Chesapeake Bay to York Furnace will be navigable. It is said that the capital backing the company will be about $10,000,000.

SALE OF NATIONAL WIRE PLANT.—It was announced last week at the office of the United States Steel Corporation that one of its subsidiary companies had purchased at receiver's sale the plant of the National Wire Corporation, at New Haven, Conn., for $650,000. The company has two large plants at New Haven, and was capitalized at $5,000,000. Although it is not definitely known which one of the subsidiary concerns of the United States Steel Corporation purchased the New Haven plants, it is understood that it is the American Steel & Wire Company. The plants have been rated at nearly twice the amount of the sale price. The concern failed about two months ago Its assets amounted to about $1,000,000 and liabilities about $3,000,000.

DENVER INTERURBAN BONDS.—The Denver & Interurban Electric Railroad, which is an auxiliary of the Colorado & Southern, has made a first mortgage to the Guaranty Trust Company, as trustee, to secure an issue of $1,250,000 6 per cent bonds, maturing July 1, 1937. This road is under construction from Denver to Louisville Junction, about 16 miles, and from that point to Boulder will use under lease Colorado & Southern tracks, aggregating 28 miles, which are to be electrified. The stock and bonds are all held in the treasury of the Colorado & Southern.

BALTIMORE CONSOLIDATION.—It is stated that there is a plan on foot to consolidate the Consolidated Gas, Electric Light & Power Company, of Baltimore, and the Baltimore Electric Company. An offer was made by interests friendly to the Consolidated a year ago for the Baltimore Electric stock, and it is reported that this offer still holds good and is now being considered. It is understood to have been $10 a share for the stock and a guarantee of the bonds, principal and interest.

CUYAHOGA TELEPHONE, of Cleveland, shows an August gross of $65,875 and net of $28,356. The net for the eight months was $232,747 and the surplus after charges $95,273, an increase over 1906 of $33,316.

GENERAL NEWS

Construction News.

CITRONELLE, ALA.—The Citronelle Light & Power Company is having plans and specifications prepared by E. N. Cunningham, of New Orleans, for the construction of a light and power plant. When plans are ready estimates will be asked on machinery and supplies. J. A. Shannon is president and S. E. Shannon, secretary and treasurer; present address, Hattiesburg, Miss.

HARTSELLS, ALA.—The Hartsells Electric Light & Power Company is being organized for the purpose of constructing an electric light plant. It is expected to have the plant in operation within eighty days. J. C. Rogers is interested in the enterprise.

TUSCALOOSA, ALA.—Architect Lockwood has been instructed to prepare plans and specifications for the building for the heating, lighting and water plant, to cost $80,000.

FLORENCE, ARIZ.—The Florence Water, Light, Ice & Power Company will soon incorporate with a capital stock of $50,000. The directors will be Dr. G. M. Brockway, P. A. Chamoer and A. C. Sieboth. The purpose of the company is to build water works, an ice plant, a gas plant and an electric light and power plant in Florence.

LITTLE ROCK, ARK.—Arrangements are being made by the St. Louis, Iron Mountain & Southern Railway Company to construct a power plant to furnish heat and light for the Union Station now under construction; light for passenger yards, heat for passenger equipment and compressed air for cleaning and brake testing. The equipment will consist of two 240-hp water-tube boilers, two 75-kw direct-connected generators, two exciters, one small generator and one air compressor having a capacity of 800 cubic feet per minute. The construction and installation will be done under the direction of Westinghouse, Church, Kerr & Company, of New York, N. Y.

ALAMEDA, CAL.—The annual report of the municipal electric light plant shows the gross earnings of $71,447 for the year, and the operating expenses to have been $44,491, making the net earnings $26,956. The plant shows a heavy increase in earnings in all departments and in net profits over the operation for the preceding year.

ALAMEDA, CAL.—The Board of Electricity is advertising for bids for additional machinery for the municipal electric lighting plant as follows: One 500-kw direct-connected alternating-current generator and cross-compound engine, or steam turbine, with switchboard panel and wiring. A. D. Goldsworthy is secretary of the board.

CHICO, CAL.—It is reported that plans are contemplated for electrifying the Butte County Railroad, from Chico to Paradise.

FRESNO, CAL.—The San Joaquin Electric Power Company is contemplating extending its transmission lines to the Mt. Campbell district and will soon extend its line to Lac-Jac. The company has recently awarded a contract for an engine to be placed in its plant, two and one-half miles above Riverdale. A. G. Wishon is manager. The company is now engaged in putting in a line to the Stokes Mountain country.

KENNETT, CAL.—The two new furnaces at the Mammoth Copper Company's smelter will be put into operation this month. A large amount of electrical motor equipment is being installed to operate the machinery in the plant. Four blowers furnish the air blast, three of which will be operated by three 250-hp General Electric induction motors, and the fourth by a 200-hp Westinghouse motor. A blower system for the converters, which is being installed, calls for a 750-hp electric motor. The hydraulic system in connection with the converters needs a 45-hp motor. There will be no overhead wires, the conduit system being used exclusively.

LODI, CAL.—The City Trustees are considering the question of submitting to the voters at the next municipal election the proposition of bonding the city for the purpose of establishing a sewer system and taking over the electric lighting plant and water works system.

LOS ANGELES, CAL.—Contracts have been let for the construction of a ten-story office building at Sixth and Main Streets. A large power plant will be installed to furnish light, heat and power for this and other buildings. The machinery will include a Corliss pumping engine, electric generators and boilers.

NAPA, CAL.—At the last meeting of the City Council the city clerk was instructed to notify the Napa Gas & Electric Company that unless a better light service was given the city, the municipality would cancel its contract with the company.

OAKLAND, CAL.—The Mono Power Company, which is backed by Edson F. Adams, of Oakland, Cal., and for which Leon M. Hall, of San Francisco, is consulting engineer, has already expended about $40,000 preliminary to installing a large power plant on the Owens River in eastern California. The company has recently let contracts for a temporary power plant, which will be used to furnish light and compressed air for driving the water tunnel leading to the permanent generating plant. The tunnel is to be 7x7 feet and 8000 feet in length, and is to be completed in six months. The energy will be transmitted about 100 miles to Goldfield and the principal mining camps of Nevada. The temporary plant that has been contracted for includes a 200-hp Ingersoll air compressor, driven by a Platt Iron Works turbine and a 75-kw generator to supply electricity for lamps and fans. The Schaw-Batcher Company has taken the contract to install 22 feet of 40-inch and 300 feet of 36-inch steel pressure pipe for the temporary installation. A 3-mile road has been completed at an expense of $25,000 into the so-called "Impassable Canyon," where the main power plant is being constructed, at a point 20 miles north of Bishop, Cal. Bids have been received on the three large generators which are to be installed in a chamber cut into the ledge of rock just above the water in the canyon.

PASADENA, CAL.—The City Council has granted a franchise to the Pacific Electric Railway Company to construct a double-track railway system in the business section of the city.

PASADENA, CAL.—Superintendent C. G. Glass estimates the cost of the improvements contemplated at the municipal electric plant at $195,000. Expert Scattergood places the figures at $245,000. Because of this difference of opinion Prof. C. L. Cory has been appointed to make a closer examination of the project.

PLACERVILLE, CAL.—The City Trustees are considering the question of constructing a municipal electric light plant.

REDLANDS, CAL.—The Edison Electric Company is said to be planning to install a new power house to utilize the waters of Bear Creek. The water will be taken through a tunnel already partly constructed.

SAN FRANCISCO, CAL.—Officials of the Metropolitan Light & Power Company state that their company has, through the Knickerbocker Trust Company, of New York, N. Y., floated an additional $600,000 of bonds for extensions and improvements to its gas plant. It is about to close a deal with the Stanislaus Electric Power Company by which it will be able to sell electricity in the city for light and power purposes. In addition to a deal with the Stanislaus Electric Company, by which the company will secure electricity from the hydro-electric plant of the Stanislaus company, the company will also have a number of auxiliary power stations in the city.

TULARE, CAL.—The Mount Whitney Power Company, of Tulare, is contemplating extending its transmission lines into the northern part of Kern County to furnish electricity to use in the development of water for irrigating purposes. The line will be extended from Porterville and will probably extend to Wasco.

MONTEZUMA, COL.—L. D. Bailor, of Lead, secretary of the Montezuma Gold Mining Company, writes that the company will not be ready to commence work on its proposed power plant until next spring.

HARTFORD, CONN.—President A. C. Dunham, of the Hartford Electric Light Company has applied to the Board of Street Commissioners for permission to install new arc lamps in the streets of the city. The company proposes to install 50 of the new lamps subject to the approval of the Common Council.

WILMINGTON, DEL.—Owing to the expense the Board of Water Commissioners has decided not to install an electric light plant in connection with the water works at the present time. The department will arrange for the water wheel by building an addition to the present gate house, where the water wheel will probably be placed at some future time.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Oct. 15, to furnish at the navy yards and naval stations the following supplies: New York, N. Y., schedule 357—transformers; Charleston, S. C., schedule 361—motors, conduit and elbows, snaking wires and electrical supplies. Also until Oct. 29, Mare Island, Cal., schedule 375—electrical fittings, etc. Also until Oct. 22, Mare Island, Cal., schedule 336—rotary blower. Applications for proposals should designate the schedules desired by number. E. B. Rogers, Paymaster-General, U. S. N.

LAKE CITY, FLA.—A company is being organized to construct a hydro-electric plant of 15,000 horse-power to supply electricity to surrounding towns. J. D. Callaway is interested in the project.

ST. AUGUSTINE, FLA.—We are informed that the St. Johns Light & Power Company is planning to construct about five miles of additional track, and will also purchase considerable new rolling stock. T. R. Ormond is general manager.

TAMPA, FLA.—The stockholders of the Tampa & Sulphur Springs Traction Company have decided to increase the capital stock of the company from $100,000 to $300,000.

ATLANTA, GA.—Bids will be received until Oct. 16 at the office of the chief quartermaster, Atlanta, Ga., for one 30-hp boiler to be delivered at Port Royal, S. C. Address Charles C. Clark, captain and acting chief quartermaster.

ATLANTA, GA.—The State Railroad Commission has authorized the Atlanta Telephone & Telegraph Company to issue $1,000,000 in bonds for the purpose of taking up outstanding bonds to the extent of $481,500, and for making extensions of its ducts and lines in and around Atlanta.

BLACKSHEAR, GA.—It is reported that the city is considering the question of building an electric lighting plant.

DUBLIN, GA.—An election will probably soon be held to vote on the proposition of issuing about $60,000 in bonds for improving the water and light plant, installing a fire alarm system and paving Jackson and Jefferson Streets.

MACON, GA.—The Macon Railway & Light Company has applied to the County Commissioners for the right of way along the Columbia road to Brown Place.

RATHDRUM, IDA.—The plant and holdings of the Rathdrum Electric Light Company have been purchased by A. O. Skinner, of Rathdrum.

SAND POINT, IDAHO.—Charles R. Foss, John C. Cleary and Peter Johnson have applied to the City Council for a franchise to operate a steam or electric railway on the streets of Sand Point.

CANTON, ILL.—Plans are being made by the Illinois Central Electric Railway to build a power station to operate a 12-mile line, and to purchase electrical equipment for the same, also three closed motor cars.

CARLYLE, ILL.—Plans are being made for enlarging the municipal electric light plant and extending the water works system.

CHICAGO, ILL.—President R. R. McCormick, of the sanitary district, states that the board will make another effort to obtain a permit from the city of Chicago for the erection of the necessary poles and wires to distribute the electrical energy to be generated by the water power at Lockport. The power plant of the sanitary district at Lockport was put into operation Sept. 25 for the first time. Edward B. Ellicott, electrical engineer, has announced that the district will be ready to furnish electricity to Chicago by Oct. 15.

FARMER CITY, ILL.—The City Council has granted the Corn Belt Interurban Railway Company a franchise for a right of way along the east city limits of the city.

PRINCETON, ILL.—Sealed bids will be received until Nov. 29 for the purchase of the municipal electric lighting plant and system, owned and operated by the city of Princeton.

SILVIS, ILL.—Preparations are being made by the Union Electric Telephone & Telegraph Company to extend its lines from Silvis to East Moline.

WATSEKA, ILL.—The Home Telephone Company and the Central Union Telephone Company have been consolidated under the name of the Watseka Telephone Company.

BICKNELL, IND.—The Town Council will receive bids for the construction and equipment of a combined water and electric plant.

BRAZIL, IND.—Among the improvements decided upon by the directors of the Brazil Farmers' Telephone Company are the installation of a new switchboard and the construction of new lines to a number of towns in the territory.

CLAY CITY, IND.—The Clay City Lighting Company is stated to be in the market for material, equipment and expert labor for the construction of an electric light plant. J. M. Long and H. R. Vandevier are among the directors.

DECATUR, IND.—The Ft. Wayne & Springfield Traction Company has decided to ask for bids for the construction of 12 miles of road from Decatur to Berne.

FARMLAND, IND.—The Farmland Telephone Company has moved its headquarters and exchange into a new building recently bought for that purpose. The company will next install a mile or more of new cable and make other improvements to the plant.

KOKOMO, IND.—Bids will be received until Nov. 8 by the Board of Public Works for furnishing electric lamps for the streets and alleys and public places and buildings in the city. J. A. Burkhalter is chairman of the board.

LAMB, IND.—The Farmers' Telephone Company will erect new lines and a telephone system in this place.

LINTON, IND.—The owners of the New Home Telephone Company, who also own or control the exchanges at Jasonville, Bloomfield, Switz City, Lyons and Worthington, have decided to expend $35,000 in the work of repairing and improving the several exchanges and building new toll lines.

MISHAWAKA, IND.—The Mishawaka Textile Company has purchased the north raceway of the local water power and will install new machinery to generate electricity for power purposes.

NORTH JUDSON, IND.—John H. Wilkinson, who bought the North Judson Telephone Exchange, has taken charge and will make a number of extensions.

BOONE, IA.—The Boone County Telephone Company has announced that it would expend $5,000 on its system in this city within the next six months. Charles C. Deering is general manager.

COUNCIL BLUFFS, IA.—The Omaha & Council Bluffs Street Railway Company has been granted permission by the City Council to build the proposed line to the School for the Deaf on South Avenue. The line will be about two miles in length, work on which will start this fall.

FORT DODGE, IA.—The officials of the Spirit Lake, Emmetsburg & Fort Dodge Railway Company, which was recently organized to construct an interurban line from Fort Dodge via Emmetsburg to Spirit Lake, which will be 62 miles in length, state that the road will be constructed without the issuance of bonds or the contracting of any debt, and also state that they are already assured of enough stock subscriptions not only to build the road, but to equip and operate it.

FORT LEAVENWORTH, KAN.—Bids will be received until Oct. 12 by Captain J. E. Normoyle, quartermaster, U. S. A., for furnishing and installing electric fixtures in eight double sets non-commissioned staff officers' quarters, one double stable guard building and two quartermasters' stables, and electric wiring in two quartersmasters' stables at this post.

LOUISVILLE, KY.—The contract for the electric light and steam-heating plant at the City Hall and engine house has been awarded to F. A. Clegg & Company, of this city.

PORTLAND, MAINE.—Bids will be received until Nov. 5 by Captain F. J. Morrow, quartermaster, U. S. A., for the construction, plumbing, electric wiring and electric fixtures, etc., for one double barrack building at Fort Williams, Maine, and one single barrick at Fort McKinley, Maine. Plans and drawings of details can be seen in the office of the quartermaster, Army Building, New York, N. Y., or 263 Summer Street, Boston, Mass.

ANNAPOLIS, MD.—The Baltimore & Annapolis Shore Line Railroad is contemplating the erection of a substation at Jones Station, about six miles from Annapolis. The equipment will be installed by the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa. Electricity for operating the cars will be supplied from the power house of the Consolidated Gas, Electric Light & Power Company at Westport.

BALTIMORE, MD.—Bids will be received until Oct. 16 by the Board of Awards (J. Barry Mahool, president) for installing a 60-hp, direct-current, 440-volt motor at the new Eastern Female High School.

TOWSON, MD.—The Chesapeake & Potomac Telephone Company has acquired a building and lot on Pennsylvania Avenue for a telephone exchange. The company will move its exchange into the building and install a new and up-to-date switchboard and other equipment.

ASHBURNHAM, MASS.—Arrangements are being made by the town officials of Ashburnham to secure electricity from the Gardner Electric Light Company to furnish electricity to operate the local electric lighting system. The company offers to furnish electrical energy to the town at the rate of 4 cents per kw-hour. The town is considering the purchase of the poles and wires of the Greene Electric Light Company, which have been offered at a reasonable price. Under the law regarding municipal lighting the proposition must receive an affirmative vote at two town meetings at least 60 days apart. As the vote in August was practically unanimous in favor of the project, it is expected that similar action will be taken at the meeting to be held Oct. 25.

CAMBRIDGE, MASS.—The Cambridge Electric Light Company has applied to the Gas and Electric Light Commissioners for permission to issue an increase in capital of $100,000, and to determine the price at which the new issue should be placed on the market.

LAWRENCE, MASS.—The capacity of the power plant of the Lawrence mills will be doubled by the installation of a steam turbine of 3000 horse-power. The machine was purchased from the General Electric Company.

LEICESTER, MASS.—The Worcester Electric Light Company is negotiating for the purchase of the plant of the Rawson Light & Power Company, of Leicester.

MARLBORO, MASS.—The Marlboro Electric Company will soon commence work on extension of its line to Northboro, where the company has secured a contract for lighting the streets. The company is also contemplating extending its lines to Westboro, and is now negotiating with the selectmen of the town for lighting the streets of the town. E. W. Godfrey is superintendent.

NORTHAMPTON, MASS.—Plans are being made for the construction of an electric railway between Northampton, Easthampton and Westhampton. Eugene D. Parks, of Russell, is interested in the enterprise.

PITTSFIELD, MASS.—The Pittsfield Electric Street Railway Company has applied to the Railroad Commissioners for permission to extend its line from West Pittsfield through the town of Hancock to Lebanon, N. Y.

STOCKBRIDGE, MASS.—The Stockbridge Lighting Company is extending its lines to the farmhouse of H. C. Eldridge on the West Stockbridge road to furnish electricity to operate an elaborate private water system.

TURNERS FALLS, MASS.—The Franklin Electric Light Company will furnish electricity for heating and cooking purposes for 5 cents per kw-hour. A monthly minimum charge of $1 will be made on meters installed. The company will renew, free of charge, burned-out incandescent lamps of 10 or more cp.

BAY CITY, MICH.—The Michigan Pipe Works is contemplating the installation of a new power plant at its works.

BAY CITY, MICH.—The National Cycle Manufacturing Company has made extensive changes at its plant in North Madison, and the entire plant will be operated by electricity.

BAY CITY, MICH.—It is reported that the Aldermen are discussing the question of removing the east side lighting plant to the old water works building on the west side.

CORUNNA, MICH.—The Shiawassee Light & Power Company, which has been lighting Corunna, Perry, Bancroft and Morrice, is now prepared to light Durand, Vernon and Byron. The capacity of the plant has been increased to 300 horse-power by the installation of a new 250-kw Warren generator, which will be doubled when the dam is raised to give a 15-foot head of water.

ESCANABA, MICH.—The Escanaba Electric Power & Pulp Company has been granted the right to furnish electricity to operate the municipal electric light plant and also for commercial lighting and power purposes for a term of ten years. The officers of the company are: O. L. Hule, of Marinette, Wis., president; J. M. Malloy, of Watertown, Wis., vice-president; P. L. Utley, of Watertown, Wis., secretary and treasurer.

GRAND HAVEN, MICH.—The Eagle Tanning Company is preparing to install electric equipment in its factory. W. H. Mead, of Holland, has the contract for the installation of the machinery. The plant has been equipped with a 300-hp engine and a 200-kw generator. Induction motors of from 15 to 50 hp will also be installed.

MANCHESTER, MICH.—Prof. John R. Allen, of Ann Arbor, has been engaged to make an appraisal on the Kingsley power plant at this place, with the idea of establishing a municipal electric lighting system. Mr. Kingsley wants $22,000 for the plant, which was established 15 years ago.

MENOMINEE, MICH.—It is reported that plans have been made by the Michigan State Telephone Company for the entire rebuilding of the Menominee system, which will include the removal of all wires along the principal streets to the alleyways and replacing the wires with cables as far as possible.

PAINESDALE, MICH.—W. O. Rankin, of Painesdale, is interested in the construction of a power plant about five miles from this town.

TRAVERSE CITY, MICH.—Work of construction by the Electric Land & Development Company on the Tyler dam site has begun near Walton Junction. The survey has demonstrated the fact that four dam sites are available; two with 40-foot head, one with 37-foot head and one with 35-foot head.

WYANDOTTE, MICH.—The contracts for the equipment for the extension of the municipal electric light plant have been awarded as follows: Arbuckle, Ryan & Company, of Toledo, Ohio, for engine, and the Westinghouse Electric & Manufacturing Company, for other necessary equipment for extension to the plant for $13,566.

BEMIDJI, MINN.—The City Council has granted a franchise to Carl C. Gowran, A. A. Carter and George W. Teitsworth to construct and operate a street railway on the streets of the city for a term of 25 years.

RED WING, MINN.—The State Board of Control has awarded the contract for installing an addition to the power plant at the Red Wing training school to the Northern Engineering Company, of Minneapolis, for $2,197.

COLUMBUS, MISS.—The Columbia Ice & Power Company, to which a franchise was recently granted, will erect an electric light plant and ice plant, the cost of which is estimated at from $40,000 to $50,000. Lee Elder, of Biloxi, Miss., is manager.

LAUREL, MISS.—The Gulf States Investment Company has been granted a 25-year franchise by the City Council for the purpose of constructing and operating an electric light and power plant.

SPRINGFIELD, MO.—It is reported that W. C. Farmer, the Springfield representative of the Pabst Brewing Company, of Milwaukee, Wis., is planning to move his electric light plant from Osceola to Springfield, to be operated in connection with the Pabst brewing establishment and cold storage plant, soon to be erected.

CENTRAL CITY, NEB.—Mr. Martin, of Fremont, has made application for a franchise for an electric light plant in this place.

FREMONT, NEB.—The city is negotiating with the Fremont Gas & Electric Light Company for the purchase of its Fremont plant and franchise.

WAHOO, NEB.—A commiteee has been appointed to make preparations and secure estimates of the cost of a municipal electric light and water plant. The members of the committee are Mayor E. Linrud, Louis Milins, E. Killian and S. P. Wahlstrom.

MORRISTOWN, N. J.—The directors of the Morris & Somerset Electric Company have decided to proceed with the work of building and equipping its plant, notwithstanding the certiorari proceedings instituted by the Public Service Corporation, decision upon which is still pending.

LAS CRUCES, N. M.—Extensive improvements are being made to the plant of the Las Cruces telephone system in this place. The office will be enlarged and cable will be installed from the central to all main leads. W. E. Baker is manager.

BUFFALO, N. Y.—The Department of Public Works is advertising for bids for four 600-hp boilers for the pumping station. F. G. Ward is commissioner.

BUFFALO, N. Y.—Bids will be received until Oct. 15 for the sale and removal of two pumping engines, Nos. 3 and 5, at the pumping station. Henry L. Lyon is Deputy Water Commissioner.

BUFFALO, N. Y.—The Economic Power & Construction Company has notified the Board of Aldermen that it proposes to begin at its convenience the construction of steam mains and electric wire conduits in most of the streets of the thickly settled parts of the city. B. L. Jones is president of the company.

CLIFTON SPRINGS, N. Y.—Plans are being made by Ford S. Burgett, owner of the grist mill and water power north of this village, for the organization of a company to develop the water power, and to furnish electricity for lighting the nearby villages.

NEW YORK, N. Y.—Bids will be received until Oct. 24 by James W. Stevenson, Commissioner of Bridges, for the electrical equipment of the University Heights Bridge.

EAST SYRACUSE, N. Y.—The Syracuse Lighting Company has submitted a proposition to the Village Board for lighting the streets of the village. The proposed contract is to run from July 1, 1907, and provides for 43 arc lamps to burn all night at $70 per lamp per year. The price under the old contract was $85. The company offers to furnish electrical power to the pumping plant for the sewer system at 4 cents on a meter basis, to be used at any time, or 3½ cents if used only between midnight and noon. It is stated that the officers of the company have agreed verbally to furnish electrical energy for private lighting at 9 cents per kw-hour for September, and after Oct. 1 at 8 cents. The old rate was 12 cents per kw-hour, with 2 cents off for prompt payment.

LOCKPORT, N. Y.—The city will soon advertise for electricity for operating the new pumping station on the grounds of the Tonawanda Iron & Steel Company, of North Tonawanda.

SYRACUSE, N. Y.—The Syracuse Independent Telephone Company will expend $450,000 in extending and improving its system in this city. J. B. Pierce is general manager.

SODUS, N. Y.—The Sodus Gas & Electric Light Company has been granted franchises in the village and town of Webster to distribute electricity and gas, which completes the franchises needed for extending its lines a distance of more than 30 miles. The company is contemplating extending its lines to East Williamson, Ontario, Ontario Center, Union Hill, Webster and West Webster on the west, and Wallington and Sodus Point on the east to build up local systems in those villages. It is also possible that the company may extend its lines to Alton and Sodus Center in this town. It is expected that when the new machinery, which was recently ordered, is installed that a day service will be furnished.

TOTTENVILLE, S. I., N. Y.—Plans are being made for the construction of an electric railway to connect Richmond, Rossville, Kreischville and Tottenville. The road will be 10 miles long and will be known as the Richmond & Tottenville Railway. The cost of the construction and equipment of the road is estimated at $400,000. Thomas B. McGovern and Cornelius G. Kloff, both of New York, are interested in the project.

WHITEHALL, N. Y.—A new 150-kw generator has recently been installed in the plant of the Consolidated Light & Power Company, which has doubled the capacity of the plant. The company has several orders to install electric signs for business houses in the town, and is planning to extend this branch of its work.

ANDREWS, N. C.—It is reported that an electric light plant will be erected in this town in the near future.

NEWTON, N. C.—The contract for the construction of the electric light plant has been awarded to the Southern Hydraulic Construction Company, of Washington, D. C.

RALEIGH, N. C.—The Agricultural & Mechanical College has awarded contracts for the installation of a power plant and electric lighting system. The total cost of the work is estimated at about $50,000. W. H. Ragan, of High Point, is chairman.

BISMARCK, N. D.—Bids will be received until Oct. 10 by the Board of County Commissioners for wiring the county courthouse. I. W. Healy is county auditor.

RUGBY, N. D.—The Brazil Telephone Company has been granted a franchise to operate a telephone system here.

CLEVELAND, OHIO.—An increase of capital stock from $100,000 to $300,000 has been announced by the Jandus Electric Company of this city.

COLUMBUS, OHIO.—The capital stock of the Ohio & Southern Traction Company has been increased from $75,000 to $90,000. F. W. Schumacher is president of the company.

COLUMBUS, OHIO.—Wade M. Ellis, Attorney-General of Ohio, has delivered an opinion to the State Board of Public Works that the franchise that has been held over the towpath of the old Hocking Canal by the Columbus, Hocking Valley & Athens Railroad Company is void, and that there is nothing in the way of leasing the property to the Logan & Athens Construction Company for the construction of an electric line from Lancaster to Athens.

HUDSON, OHIO.—A citizen of Hudson has decided to construct and present to this town an electric light plant and water works system, to cost about $100,000. Dr. W. I. Chamberlain and G. Mead will be trustees for the donor and Mayor E. L. Filius will represent the town.

NEW BREMEN, OHIO.—An election will be held in this village Nov. 12 to vote on the proposition to issue $20,000 in bonds to purchase the electric light plant. The plant is owned by private parties, who, it is stated, are willing to sell.

SPRINGFIELD, OHIO.—The City Council on Sept. 26 passed a resolution authorizing the Service Board to advertise for bids for lighting the entire city at the expiration of the present contract, which will expire Jan. 7, 1911. The construction of a municipal plant is said to be favored by many of the councilmen.

TOLEDO, OHIO.—The Citizens' Lighting & Heating Company has applied to the City Council for a franchise to furnish light, heat and power in Toledo. C. S. Ashley is interested in the company.

TOLEDO, OHIO.—A franchise has been granted to the People's Heat & Power Company to operate a heat and power plant in the city. The company has agreed to spend $200,000 on the west side of the river and $100,000 on the east side within two years, and to put up certified checks for $30,000 with the clerk of the Council as an insurance of good faith. The company is not allowed to merge with any other than the company now controlled by Homer T. Yaryan, who is also the promoter of this company. The city buildings are to be furnished with heat and power at half price.

WARRENSVILLE, OHIO.—Bids will be received until Oct. 18 by the Board of Public Service, Cleveland (A. R. Callow, secretary), for installing complete electric wiring and conduits in the new quadrangle building of the Cleveland Farm Colony at Warrensville.

WOOSTER, OHIO.—It is announced that the Wooster & Mansfield Electric Railway Company has secured all the right of way for its proposed railway to connect Wooster and Mansfield. Davis Collier is vice-president of the company.

HENNESSEY, OKLA.—The capital stock of the Hennessey Electric Light, Power & Ice Company has been increased from $15,000 to $30,000.

THOMAS, OKLA.—The city proposes to establish an electric lighting plant in connection with the water works system. The cost of the combined plants is estimated at $30,000. The O'Niel Engineering Company, of Dallas, Tex., has charge of the construction work.

ALBANY, ORE.—The City Council has granted a franchise to A. Welch to operate a street railway on several streets of the city for a term of 25 years.

EUGENE, ORE.—A committee has been appointed to raise $20,000 for an electric railway to run through the Willamette Valley from Eugene to Portland. P. E. Snodgrass, Walter Griffin, A. C. Woodcock and others are on the committee. A corporation is to be organized to complete the project for an electric line already commenced by A. Welch and associates.

HAINES, ORE.—J. W. Anderson, vice-president of the Baker City Light & Power Company, states that his company is planning extensive improvements to its Rock Creek plant.

PANAMA.—Bids will be received until Nov. 4 at the office of H. F. Hodges, general purchasing officer, Isthmian Canal Commission, Washington, D. C., for electric fixtures, etc., as per circular No. 396.

BUTLER, PA.—A charter will be applied for a company to be called the Butler & Chicora Street Railway Company, which proposes to construct a street railway from Butler to Carns City, East Brady and Kaylor. The application will be made by John Daly, W. J. Morgan, W. Criswell, W. G. Stern and E. W. Dewey.

CHAMBERSBURG, PA.—The Town Councils of Chambersburg and Greencastle have granted franchises to the Chambersburg, Greencastle & Waynesboro Street Railway Company for the proposed extension from Greencastle to Chambersburg and over certain streets in Chambersburg.

RIDGWAY, PA.—The property of the Ridgway Electric Light Company changed hands on July 1, and the new company is building a new plant, which is expected to be in operation by Dec. 1. The machinery to be installed comprises one 110-hp and two 125-hp Warren gas engines; one 50-kw and two 75-kw, 1100-110-volt, 60-cycle, two-phase, Crocker-Wheeler generators. C. H. Law is manager.

RIEGELSVILLE, PA.—John S. Riegel, of this place, has under consideration the construction of a large water power plant on the Delaware at the Narrows' lock to furnish power to operate his paper mill at Milford.

STROUDSBURG, PA.—The Stroudsburg Passenger Railway Company is contemplating the installation of a new water turbine and storage battery in its power station next spring. E. F. Smith is general manager.

WOMELSDORF, PA.—W. W. Lengel, borough secretary, writes that bids will be received on Oct. 15 for the construction of an electric light plant, to cost about $15,000. F. W. Darlington, Real Estate Trust Building, Philadelphia, is engineer.

PAWTUCKET, R. I.—The Pawtucket Electric Company has announced a new rate of sign advertising of 15 cents per month per lamp for lamps of 4 cp, to be burned every night except Sunday, from 6 p. m. until 11 p. m., with a minimum charge of $1 per month. From this rate there is a reduction of 5 per cent if bills are paid before the tenth of the month.

MARION, S. C.—On account of the unsatisfactory service in furnishing water and light to the town by the Marion Water, Light & Power Company, the town is suing the company for $60,000 damages and asking that a receiver be appointed, and further that the franchise granted by the town be rescinded and annulled. The franchise under which the company has been operating, granted by the town upon the vote of the taxpayers, is an exclusive one. The Town Council is considering the question of furnishing its own overhead system and to purchase electric energy from the Marion County Lumber Company or the Carolina Yellow Pine Lumber Company.

ABERDEEN, S. D.—C. F. Freehauf, of Cresco, Iowa, has declined the franchise for the construction of an electric light plant, recently granted by the City Council. The franchise was for a term of 25 years.

EDGEMONT, S. D.—Chris Jensen, owner of an independent telephone system operating through the southern hills, is contemplating extending his system to cover the whole Black Hills country.

ALVIN, TEX.—It is reported that E. N. Sanctuary and Mr. Durland, of Galveston, are contemplating establishing an electric lighting plant in Alvin.

GONZALES, TEX.—The Gonzales Telephone Company is contemplating extensive improvements to its system at Smiley. A new switchboard and cables will be installed.

HOUSTON HEIGHTS, TEX.—The new machinery for the plant of the Houston Heights Water & Light Company has been received and installed. The new machinery includes two 100-hp boilers, a 250-hp engine and a dynamo of 150 kw capacity. The cost of equipment is about $25,000 and gives the plant a capacity of 6000 lamps.

LAREDO, TEX.—Capitalists of San Antonio and Southwest Texas are planning the construction of an electric plant at Rio Grande coal mines to furnish power for irrigating several thousand acres of land between the mines at Laredo. The plans include the construction of a transmission line to Laredo, a distance of 26 miles, where a substation will be erected to furnish the city of Laredo with electricity for lighting purposes. The cost of the work is estimated at about $100,000, work on which, it is stated, will begin within two months. Samuel Kahn, chief engineer of the San Antonio Traction Company, will have charge of the work.

SAN ANGELO, TEX.—President J. H. Ransom, of the proposed street railway system, states that work will commence on the construction of the power house within 60 or 90 days.

PROVO, UTAH.—Plans are being made by W. H. Lepper, architect, for the construction of a large electrical plant on the Bear River, near Grace, which, when fully developed, will have a capacity of 40,000 horsepower. At present the design is for a plant of half that capacity. The power will be supplied by water from the Bear River. The system is to be operated in connection with the Provo River system.

BENNINGTON, VT.—The question of installing an electric lighting plant at the Vermont Soldiers' Home for the purpose of lighting the buildings of the institution is now under consideration. The buildings are now lighted by the Bennington Light & Power Company at an annual expense of about $600.

ST. ALBANS, VT.—The Vermont Power & Manufacturing Company has made a contract for the erection of a duplicate transmission line between its plant at Fairfax Falls and Bennington.

FREDERICKSBURG, VA.—The Fredericksburg Water Power Company will soon commence work on the construction of a reinforced concrete dam across the Rappahannock River, one mile above the city, which will cost $60,000.

DEER PARK, WASH.—The Board of County Commissioners has granted to A. M. Wood and R. H. Long a franchise for an electric lighting system in Deer Park.

SEATTLE, WASH.—The City Council has granted a franchise to the Loyal Railway Company to construct and operate an electric railway in Seattle.

SEATTLE, WASH.—A syndicate headed by J. A. Moore has been formed to develop the old university tract. Plans will be prepared immediately for the construction of the first of the buildings, which will consist of two six-story buildings on Union Street, between Fourth and Fifth Avenues, at a cost of about $500,000. A large heating and lighting plant will be erected on the grounds to light and heat all the buildings on the tract.

VANCOUVER, WASH.—The Washington Railway & Power Company has been reorganized and the assets taken over by local capitalists. The officers of the new company are: E. M. Rands, president; J. H. Elwell, vice-president; H. C. Phillips, treasurer and M. M. Conner, secretary. The company estimates that it will cost about $75,000 to complete the city system and the first four miles extension.

WALLA WALLA, WASH.—C. L. Whiting has applied to the City Council for a franchise to construct an electric railway from Fourth and Alden Streets to the fair grounds.

CHARLESTON, W. VA.—The capital stock of the Charleston Home Telephone Company has been increased from $300,000 to $600,000, the proceeds to be used for further extensions of the system.

ELKINS, W. VA.—The Elkins Power Company is contemplating the construction of an electric light and power plant, the cost of which is estimated at about $35,000. The engineer has not yet been selected. John T. Davis is president; N. I. Hall, secretary and manager; C. C. Bosworth, superintendent.

GRAFTON, W. VA.—It is reported that the Grafton Traction Company will extend its lines to West Grafton and South Grafton. The company has decided to extend its system to Blueville, a suburb two miles east of the city, and is also contemplating extending the line to Pruntytown, Webster, Simpson and other towns in the west end of the county.

PRINCETON, W. VA.—The Princeton Power Company, recently incorporated with a capital stock of $25,000, will establish an electric power plant in this place. E. S. J. Evans is general manager.

LUCK, WIS.—Peterson Brothers have been granted a franchise to erect an electric light plant in this village.

MILWAUKEE, WIS.—City Attorney Kelly has notified the City Council that the city of Milwaukee cannot enter the field of commercial lighting without first presenting its case to the State Railway Rate Commission and showing that there is a necessity for such action.

STRATHCONA, ALB.—The Edmonton City Council is negotiating with the Council of this town for the purchase of electrical energy. The town has decided to sell Edmonton the energy required at 7 cents per kw-hour, the purchaser to furnish the transmission lines. Address Mayor May, Edmonton, Alb., or City Electrician Ormsby.

KINGSTON, ONT.—The City Council has decided to ask the Hydro-Electric Power Commission for Ontario to give the municipality an estimate of the price to be charged for 1000 to 2000 horse-power to be supplied at the power station to be distributed by the municipality.

OTTAWA, ONT.—Negotiations are being made for the purchase of the Ottawa Electric Railway Company, the Ottawa Electric Light Company and the Ottawa Gas Company by an American syndicate.

SARNIA, ONT.—The Town Council has granted the Sarnia Street Railway Company permission to construct a railway line, a distance of about one and one-half miles. It is expected that work will commence this fall, and the company will be in the market for poles, wire and electric equipment for the overhead work.

SUDBURY, ONT.—The Ontario Railway and Municipal Board has approved the application of the by-law of the town for providing for the extension of the water works and electric lighting system. Debentures to the amount of $10,000 will be issued.

MEXICO CITY.—Charles H. Cahan, attorney of the Mexican Light & Power Company, Ltd., states that a second large hydraulic plant on the Necaxa River has been decided upon. It will be installed near Huachinango and will cost $5,000,000. R. F. Hayward is general manager.

New Industrial Companies.

THE ANDERSON-LACY ELECTRIC HEADLIGHT COMPANY, of Houston, Tex., has been incorporated with a capital stock of $10,000 for the purpose of manufacturing electric headlights. The incorporators are: H. T. D. Wilson, T. J. Anderson and B. B. Lacy.

THE ELECTRIC HOME SUPPLY COMPANY, of New York, N. Y., has filed articles of incorporation with the Secretary of State with a capital stock of $10,000. The directors are: Cornelius D. Wood, Jr., Max Loewenthal and Solomon P. Mendel, of New York.

THE GREEN INSULATION COMPANY, of Cleveland, Ohio, has been incorporated with a capital stock of $50,000 by J. E. Chadwick, D. J. Barry and others.

THE REVERSIBLE ROTARY ENGINE COMPANY, of Douglas, Ariz., has been incorporated by M. E. Donohue, J. F. Hassey and M. J. Hassey. The company proposes to manufacture steam engines, boilers and machinery.

THE GEORGE H. RICE COMPANY, of Brooklyn, N. Y., has filed articles of incorporation with a capital stock of $40,000. The purpose of the company is to do electrical engineering and the directors are: George H. Rice, John J. Holshush and Thomas H. Harvey, all of Brooklyn.

THE UNIVERSAL CARBON TRUST COMPANY, of Adams, Mass., has been organized for the purpose of manufacturing carbon. The trustees are: R. N. Richmond, of Adams; C. J. Howe and Enoch H. Beer, of North Adams.

THE ZOAR BATTERY COMPANY, of Zoar, Ohio, has been incorporated with a capital stock of $30,000 by John Bimeler and others.

New Incorporations.

SAN FRANCISCO, CAL.—The Hanbridge-Loyst Electric Company has been incorporated with a capital stock of $25,000 by W. W. and G. G. Loyst and W. S. Hanbridge.

SAN FRANCISCO, CAL.—The Central Electric Company has filed articles of incorporation with a capital stock of $25,000. L. R., H. W. and J. L. Boynton are the incorporators.

NAPA, CAL.—The Napa & Lakeport Railway Company has been chartered with a capital stock of $2,000,000 to build a road from Napa to Lakeport, a distance of 90 miles, with a branch to Monticello, 14 miles in length. The incorporators are E. C. Amedee of San Francisco, A. J. Brown and W. F. Ansell of Alameda County.

NAPA, CAL.—Articles of incorporation have been filed for the Napa Valley Electric Company with a capital stock of $200,000. The company proposes to conduct and carry on the business of generating, buying and furnishing electric energy for lamps, heaters and motors; to acquire and operate electric light, heat and power plants and systems; and also to operate gas plants. The board of directors for the first year consists of Attorney Percy S. King, Derrel L. Beard and Henry Brown, of Napa, and Dr. G. S. Conner and H. J. Lewelling, of St. Helena.

TRINIDAD, COL.—The Stonewall Valley Electric Railroad Company has been chartered with a capital stock of $100,000 by P. M. Johnson, of St. Elmo, Ill.; Frank P. Read, James McKeough and J. C. Huddleson, of Trinidad. The company proposes to extend the Trinidad Street Railway from Cokedale through the Stonewall Valley into the Stonewall Mountains.

GARYSBURG, N. C.—The Farmers' Mutual Telephone Company has been incorporated with a capital stock of $25,000 to build a telephone line from Garysburg to Roanoke Rapids. The incorporators are W. H. Joyner and others.

WELLSVILLE, PA.—The Dillsburg & Wellsville Railroad Company has been granted a charter by the Secretary of State to build an electric railway from Dillsburg to Wellsville, a distance of 7½ miles. The capital stock of the company is placed at $75,000, and the directors are Augustus C. Hetrick, of Wellsville, president; Hobert J. Beet, Joseph Milligan, W. D. Brougher, J. J. Seiple, J. N. Logan, Edward W. Shapley, Daniel W. Beitzel and S. G. Bushey.

HOUSTON, TEX.—The Galveston-Houston Electric Company has been organized by the Stone & Webster interests, of Boston, Mass., with a capital stock of $6,000,000 as a holding company for the Houston Electric Company, the Galveston Electric Company and the Galveston-Houston Electric Railway Company, which has been organized for the purpose of constructing an interurban line between Houston and Galveston, a distance of 52 miles. The road will run on private right of way, for which surveys have been made.

BURLINGTON, VT.—Articles of association have been filed with the Secretary of State for the Green Mountain Lighting & Heating Company. The company proposes to manufacture, sell and deal in lighting and heating plants, etc. The company is capitalized at $15,000, and the incorporators are G. S. Blodgett, C. D. Ordway, J. P. Cobb, of Burlington; W. M. Spear, John T. Spear, of Charlotte, and others.

TACOMA, WASH.—The Aztec Power Company has been incorporated with a capital stock of $25,000 by A. R. Warren and others.

TOMAHAWK, WIS.—The Tomahawk Power Company has been incorporated with a capital stock of $25,000 by R. A. Curtis, A. R. Reid and others.

Legal.

ELECTRIC COMPANY HELD NOT LIABLE FOR FIRE CLAIMED TO HAVE BEEN CAUSED BY TROLLEY WIRE.—A mill belonging to one Imeson, located at Midland, Washington, having been destroyed by fire, Imeson made a claim against the insurance company with which he carried insurance on the destroyed property. It was Imeson's conception that the fire was caused by the falling of a trolley wire belonging to the Tacoma Railway & Power Company and in filing his claim for insurance he gave this as his belief as to the origin of the fire. The insurance company, upon paying the insurance money, took a subrogation receipt from Imeson and then an action was begun by Imeson and the insurance company jointly to recover the amount of the loss. Imeson himself was acting as watchman on the night of the fire, and he stated in his testimony that, upon discovering the conflagration, he went to the rear of the mill for the purpose of starting the pumps. In doing so he crossed the tracks of the electric railway company, over which was strung the wire which he claimed was responsible for the fire. But he did not notice the wire at the time and it was not until after the fire had burned out that the wire was found lying on the ground. It was held that as it was hardly possible that Imeson could have passed over the wire without having in some way become apprised of its presence, the presumption was that the wire fell after the fire had started and that the electric railway company could not, therefore, be held liable in damages. Imeson vs. Tacoma Railway & Power Company, Supreme Court of Washington, 84 Pac. Rep. 624.

TELEPHONE COMPANY OPERATING UNDER ORDINANCE FIXING RATES PRECLUDED FROM CHARGING HIGHER RATES.—The ordinance of the city of Chicago, passed Jan. 4, 1889, which granted permission to the Chicago Telephone Company to construct and operate its system in that city for a period of twenty years, prohibited the company from increasing to its subscribers at any time the rates for telephone service when established. Some time after the granting of the privilege the telephone company presented to its patrons in the city of Chicago propositions to enter into what they called "special service contracts," by which the patrons, taking advantage of the benefits so offered, were to have the improved service at higher rates than were charged at the time of the passing of the ordinance. This scheme of presenting to the patrons an option to retain the antiquated service at the ordinance rate or to have a better and more satisfactory service at a higher rate resulted in the substitution of the better service as to a very large majority of the company's subscribers. In quo warranto proceedings against the company the claim of the company as to the improvements in service was that a proper construction of the ordinance only required it to furnish the same style of service and equipment that was furnished when the ordinance was passed at the rate then fixed and that it could charge a higher rate for better telephone service if the patrons agreed to the special service contracts. But it was held, contrary to the company's contention, that if higher rates than those fixed by the ordinance were charged to subscribers in the city of Chicago during the period of the grant the same would constitute a breach of the contract which arose between the company and the city upon the acceptance of the ordinance by the company. People vs. Chicago Telephone Company, Supreme Court of Illinois, 77 N. E. Rep. 245.

POWER COMPANY HELD NOT LIABLE FOR INJURY BY CONTACT WITH LIVE WIRE.—During a very severe wind storm two uninsulated electric wires belonging to the Grande Ronde Electric Company, having a power plant at Cove, Ore., where it generates electricity which is transmitted to La Grande and Hot Lake for supply to consumers, were blown down. The owner of the land upon which the wires fell, apprehending danger from one of them, by using a dry stick looped the end over a picket in a fence surrounding his property. Various tests were tried by the persons living in the vicinity to find out whether the wire was still possessed of electrical energy and one of the experi-

menters received a shock from which he did not fully recover for several days. One of the farm workmen, although aware of the fact that several persons had had experiences with the wire indicative of danger, seized the picket fence to which the wire was fastened with one hand, and, in his ignorance of electricity, pointed the index finger of his other hand in the direction of the wire. The wire carried 23,500 volts and when the workman's hand approached within about eight inches of the wire, the one or two spectators who happened to be there saw a sudden flash of electricity which caused the workman's death. In the action against the power company for damages the defense of contributory negligence was depended upon and it was held that though the company was guilty of negligence the workman's negligence also contributed to the accident and that, therefore, the company could not be held in damages. The care which the law exacts from any person or corporation engaged in operating a dangerous instrumentality is always in proportion to the degree of danger reasonably to be apprehended from the use of the means employed. Electricity is a natural force, the power of which is fully comprehended only by experts, and the wires conducting it should be placed and kept beyond the reach of people who have no conception of the danger to which contact will necessarily expose them. But, where, as in the present case, a man of mature years, with knowledge that other persons have come to grief by getting into too close proximity with a live wire is injured through a desire to see how near he can place his finger to the wire without sustaining a shock, there is contributory negligence and damages cannot be collected. Carroll vs. Grande Ronde Electric Company, Supreme Court of Oregon, 84 Pac. Rep. 389.

Educational.

WASHINGTON UNIVERSITY.—The electrical engineering department of Washington University, St. Louis, Mo., received recently, as a donation from the United Railways Company of St. Louis, a pair of G. E. 800 railway motors, appropriately mounted for the regulation standtest; a K-2 controller and necessary resistance grids, and a tap from the feeder system of the company into the laboratory building.

Personal.

MR. N. F. BRADY, treasurer of the New York Edison Company, has returned from Europe, where he spent the summer months with his wife.

MR. HARALD WALLEM and Mr. C. F. Schrottke, chief engineers of the Siemens-Schuckert Werke, Berlin, are now making their first visit to this country for the purpose of seeing the progress that has been made here in high-tension electrical engineering. They will be in and around New York during the first two weeks of October.

MR. ALPHAMEO MORRILL, who has served the Salem Electric Lighting Company, of Salem, Mass., as superintendent for nearly twenty-five years, has been promoted to the office of assistant to the manager and Mr. Harry Kingsley, who has been assistant superintendent under Mr. Morrill, has been promoted to the position of superintendent.

MR. ROBERT W. CLARK, manager of the Union Light, Heat & Power Company, of Fargo, N. D., has resigned to accept a position with the Minneapolis General Electric Company, of Minneapolis, Minn. Mr. Clark will remain in Fargo until Nov. 1 to complete the work in connection with the reconstruction of the plant of the Union Light, Heat & Power Company. Mr. W. H. Thompson, Jr., of St. Paul, Minn., will succeed Mr. Clark.

DWIGHT-KIRCHHOFF.—The marriage took place on Sept. 26, in New York City, of Mr. Theodore Dwight to Miss Linda Kirchhoff, sister of Mr. C. Kirchhoff, editor of the *Iron Age*. The honeymoon has been spent in the recesses of the Adirondacks. Mr. Dwight, well-known to electrical engineers from his early Thomson-Houston affiliations, was more recently assistant secretary of the American Institute of Mining Engineers and a member of the committee to erect the new Enginering Societies Building. He is a member of the board of the Engineers' Club and chairman of the Library Committee.

MR. PUTNAM A. BATES, 42 Broadway, New York, announces that to insure the best results, from the point of view of operation, he has extended his field of engineering to include heating and ventilating, where problems in these branches have to be solved in conjunction with electric lighting and power installations. Owing to the close intimacy of these four branches of engineering, and the fact that the proper solution of the problems of one often depended upon the disposition of the others, he has decided that the best interests of his clients will be served in cases where these problems are thus interlinked, by having them treated under the direction of one mind. To this end he has added to his staff assistants whose training and experience has fitted them especially for directing and carrying out the details of such work.

MR. J. G. WHITE, head of the American and British corporations of J. G. White & Company, is the subject of a sympathetic illustrated article in the October *Review of Reviews*. It is under the title, "A Yankee Engineer on Five Continents," and is written by Mr. David F. St. Clair, who gives many interesting details about a notable personality. Mr. White, it is said, "is one of the great silent forces at this moment in the world's industrial development; silent because his work and policies nowhere directly affect politics. As the engineer, contractor and business man, this quiet dynamic man is building up the world's industrial forces without seeking to control or exploit them. * * * With him, the engineer became his own contractor, and the magnitude of the work commanded the alliance and partnership of the banks."

Trade Publications.

BATTERIES AND SPARK COILS.—If gas engine owners understood that the success and regular running of their engines depended more on the reliability of their ignition than anything else, they would, of course, be careful to buy only batteries and spark coils which had proved these qualities during the severest tests. The Edison primary battery and the Edison spark coil have been used under the most unfavorable conditions, in all climates, with perfect satisfaction. The Edison primary battery possesses constant and high electro-motive force and is able to withstand heavy currents without damage because of its very low internal resistance, which in the largest Edison cell is only 0.02 ohm. The two appliances naturally complement each other. Full particulars are given in an interesting booklet, "Battery Sparks," sent free to any reader on receipt of a postal by the Edison Manufacturing Company, 10 Fifth Avenue, New York.

THE CURTIS STEAM TURBINE-GENERATOR is the title of a large pamphlet (No. 4531), issued by the General Electric Company, Schenectady, N. Y. The printing and general style of the pamphlet are very attractive, but will be found of a special interest to engineers on account of the information given with regard to superheat, vacuum, consumption, etc., and the details of construction and operation of all parts of the Curtis apparatus. Under the heading of "Economy," detailed tests are given of 9000-kw, 5000-kw, 2250-kw and 1000-kw turbines, which show some very remarkable high efficiencies. The advance made by this type of turbine is illustrated by the statement that nearly 1,000,000 kw of Curtis steam turbine-generators have been sold. Special attention is called to the flat efficiency curve, giving high efficiency at overloads and light loads, the simplicity of design, the low maintenance, the economy in space, etc. This publication seems to be typical of the recent desire to have such information written by and to engineers, and the following synopsis of its contents will show the wide field covered: Advantage of vertical-shaft type, economy of space, building materials and steam, clearances, flow of steam, balance, lubrication, the construction of buckets, governors, foundation, low-pressure turbines, vacuum, regulation, parallel operation, ventilation, consumption, etc. Of the illustrations, the following may be taken as having special interest: Those showing the interior of the Fisk Street Station at Chicago and cross sectional view of a 9000-kw turbine, the method of cutting and riveting buckets, the hydraulic governor, low-pressure turbine sets installed, and consumption curves.

Business Notes.

PORCELAIN SIGNS.—The Colonial Sign & Insulator Company, of Akron, Ohio, has just been notified by the board of underwriters that its porcelain electric sign letters were approved on Sept. 10.

THE CROCKER-WHEELER COMPANY announces that its Birmingham, Ala., office has been changed from 2119 Third Avenue to the Woodward Building, that city, where all communications relative to business in that territory should now be addressed.

THE CENTRAL ELECTRIC COMPANY, of Chicago, reports very large sales on Stanley G-I arc lamps, for which it is agent. The company claims for the new type "K" lamp that it is the simplest on the market, and asserts that no matter what the conditions of current or circuit it can furnish a type "K" lamp which will give good light, and do it economically. The company is sending out to its trade special bulletins on this lamp, and invites requests for descriptions and prices.

HILL CLIMBING CARS.—The electric car is generally considered a convenient and elegant town equipage, but its horse-power is not high as compared with that of gasoline cars; gasoline is therefore generally considered as putting electricity out of the running when it comes to hill climbing or other time contests. But intelligent cutting out of the various elements that decrease efficiency can do much. The Woods electrics have cut out journal friction by the liberal use of Hess-Bright ball bearings in the motor and running gear. As a result at the Algonquin Hill climb on Aug. 9 this year many a big and small gasoline car was unable to approach the time made by the Woods electrics.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is receiving a great many inquiries and orders for the Just tungsten lamps, for which it is Western distributor. The company is at present importing only the standard 40-cp lamp, Edison base, 105 to 120 volts. These lamps consume but 1 watt per candle, representing therefore a saving of 70 per cent over the 3½-watt carbon filaments. The lamps are packed with the tip downward and shipped in a special package to assure their being kept this way while in the hands of the transportation company. Since the adoption of this package the Central Electric Company asserts that reports from its customers of breakage of filament have been rare.

TRUMBULL ELECTRIC MANUFACTURING COMPANY.—A Plainville (Conn.) journal in a recent issue devotes several columns to an account of the Trumbull Electric Manufacturing Company, the occasion being the completion and occupancy of a large addition to the factory of that company. The Trumbull Company began business in Feb., 1899, with Messrs. Frank T. Wheeler, president; John H. Trumbull, treasurer, and Andrew Trumbull, secretary, who still occupy these positions. The building originally occupied by the old factory is now used as a storeroom. In 1901 a large building was added to the plant, and a year and a half ago a four-story addition was found necessary. The capacity of this was soon outgrown and the new building just erected almost doubles the capacity of the plant.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCT. 1, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

867,236. PIPE-CAP; William H. Blood, Jr., Wellesley, Mass. App. filed Jan. 19, 1907. A form of hood or cap designed to be applied to the vertically projecting end or terminal of a conduit pipe, for example, at the telephone circuit connections for a dwelling. The conduit pipe has an annular collar with a hood and means for simultaneously securing the hood to said collar and the latter to a support.

867,256. SUBAQUEOUS LIGHT SYSTEM; Leon Dion, Wilkes-Barre, Pa. App. filed Nov. 6, 1906. Renewed July 10, 1907. The method of imparting safety to navigation, consisting in illuminating the course by a series of submerged practically fixed lights.

867,257. FUSE BOX SUPPORT; James S. Doyle, New York, N. Y. App. filed Jan. 24, 1907. Construction of fuse box for street railway cars designed to prevent injury by the jar and vibration. Has yielding means for supporting the fuse box.

867,312. ELECTRIC WIRE CONNECTOR; John A. Shutz, Richmond, Ind. App. filed Dec. 3, 1906. The connector has two surfaces which are tightly wedged into contact with one another by compression springs.

867,317. ATTACHMENT FOR ICE BOXES; Winfield W. Stevenson, Philadelphia, Pa. App. filed April 11, 1906. An electric switch or device which serves to automatically turn on the lights within a refrigerator when the door is opened.

867,319. ELECTRODE; John W. Stubbs, Middlewich, England. App. filed April 9, 1907. Relates to electrodes having conductors partly protected from the electrolyte and carbon blocks connected to the conductors and exposed to the electrolyte. Provides a composition of high conductivity which may be molded around the ends of the conductors to protect them while the surface of the mass or composition may be finished to a form which can be readily fitted into the usual external carbon blocks so as to render renewal of the latter easy.

867,320. ELECTROLYTIC PROCESS AND PRODUCT; Clinton P. Townsend, Washington, D. C. App. filed April 24, 1905. The process of producing lead oxide which consists in decomposing a suitable electrolyte with an anode of lead and producing compounds in which lead occurs in the basic and acid radicals respectively, and effecting a reaction between said compounds.

867,329. BLOCK SIGNAL APPARATUS; Frank C. Williams, Philadelphia, Pa. App. filed July 17, 1905. The patentee has a pair of trolley poles upon the locomotive cab which engage depending plates connected in the circuits of semaphore apparatus along the track.

867,331. AUTOMATIC SAFETY CONTROLLING MEANS FOR TRAINS; David S. Affleck, Chicago, Ill. App. filed Aug. 16, 1906. Specific construction of an engineer's valve and throttle operating apparatus by which a locomotive is automatically stopped by the completion of circuits from the track rails dependent on the position of a preceding train.

867,349. TESTING SYSTEM FOR TELEPHONE LINES; W. W. Dean, Chicago, Ill. App. filed July 27, 1903. In a telephone system, the combination with a plurality of cord circuits, of a test responsive device common to said cord circuits, a sleeve supervisory relay associated with the answering end of the cord circuit, and contacts of said relay in the circuit of said test responsive device, substantially as described.

867,364. AUTOMATIC RAILROAD SIGNAL; William H. Harris, Stark, Mont. App. filed Jan. 9, 1907. Provides means to notify the engineer and train crew, as well as the despatcher's office where a train is located on the line. Has a step-by-step device analogous to a messenger call.

867,391. STORAGE-BATTERY PLATE OR GRID; Joseph Marx, Buffalo, N. Y. App. filed Jan. 30, 1907. Storage-battery plate comprising a frame embodying spaced side bars, top and bottom bars and horizontally extending shelves with ribs.

867,406. RAIL BOND; Lewis T. Pates, Upper Alton, Ill. App. filed Dec. 26, 1906. Form of rail bond having forked extremities which are driven through divergent holes in the rail flange so as to be locked therein by said divergence.

867,415. RAIL BOND; Frank W. Richey, Chicago, Ill. App. filed Dec. 5, 1902. Rail bond formed of ribbons bent so as to avoid breakage by expansion and contraction of the rails and pressed into copper heads.

867,416. ELECTRICAL CONDUCTOR; Frank W. Richey, Schnectady, N. Y. App. filed Feb. 10, 1904. Relates to modifications of the above.

867,436. LEAD PIGMENT AND SIMILAR COMPOUNDS; Elmer A. Sperry, Brooklyn, N. Y. App. filed Aug. 30, 1906. Process of producing lead compounds of salts such as are used for pigments.

867,440. THREE-WIRE MOLDING RECEPTACLE; James S. Stewart, New York, N. Y. App. filed June 29, 1906. Relates to several features of improvement in molding wire receptacles and particularly of the three-wire type. The receptacle is designed to make connection with one branch or the other of the three-wire system, being systematically placed on the three-wire molding in all cases. For this purpose the axis of the threaded shell lies directly over the central wire, the remaining terminal clip falling over one of the outside wires. An additional feature of the invention lies in the vitreous coated or stoneware metal outside housing for the receptacle.

867,448. SIGNALING SYSTEM FOR RAILWAYS; Louis H. Thullen, Edgewood, Pa. App. filed June 23, 1906. Relates to signaling systems for railways and especially to railways the track rails of which are included in and form part of the return path or conductor to the generator for the current employed for propelling motor cars along the railway.

867,452. ELECTROLYTIC BLEACHING OF COTTON; August A. Vogelsang, Dresden, Germany. App. filed Sept. 21, 1901. Relates to improvements in electrolytic bleaching of cotton and textile materials.

867,456. ELECTRODE FOR ARC LAMPS AND METHOD OF MAKING THE SAME; William S. Weedon, Schenectady, N. Y. App. filed Dec. 10, 1903. An arc lamp electrode containing the suboxide of titanium.

867,475. MOTOR STARTING RHEOSTAT; Eugene R. Carichoff, East Orange, N. J. App. filed May 25, 1905. Circuit controller having a plurality of resistance units in series, a short-circuiting device for each unit, a movable controlling element and means whereby said devices may be successively operated to cut out said resistance units by moving said element from any position as a starting point.

867,476. SYSTEM OF CONTROL; Eugene R. Carichoff, East Orange, N. J. App. filed Jan. 19, 1906. Relates to modifications of the above.

867,482. LOCKING MECHANISM FOR CONTROLLER HANDLES; Archibald S. Cubitt, Schenectady, N. Y. App. filed Jan. 2, 1906. Mechanical construction of the handle of a controller having a locking lever depressed by a button on the handle.

867,494. FIRE ALARM TELEGRAPH SYSTEM; Manious Garl, Akron, Ohio. App. filed Oct. 20, 1905. A fire alarm system magneto electric telegraph designed to avoid all batteries at local stations.

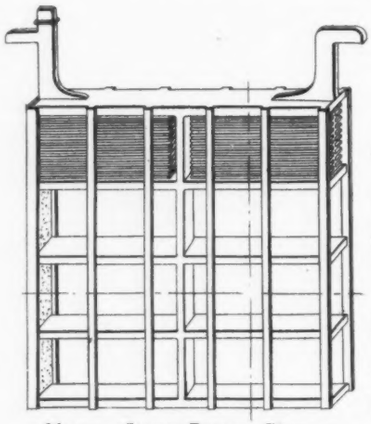
867,496. FUSE; Henry Heisenhoner, Schenectady, N. Y. App. filed June 29, 1903. The fuse is embedded in a compound which expands and compels the contacts to separate widely when the fuse blows.

867,509. ELECTRIC SWITCH; Edwin Johnson, Schenectady, N. Y. App. filed Aug. 24, 1905. Relates to mechanical cut-outs for electric circuits. Has two sets of contacts and a contact disc actuated by a spring pressed stem and a toggle lever.

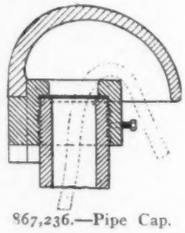
867,517. METHOD OF PRELIMINARY TREATMENT FOR ACCUMULATOR-PLATES; Henry Leitner, Maybury, Woking, Eng. App. filed Aug. 25, 1904. Preliminary treatment of an accumulator-plate by the use of which the formation of the plates treated on the Plante principle is facilitated. Makes use of a high current density and has artificial means for keeping the electrolyte cool.

867,519. ELECTRIC FURNACE; John T. Marshall, Metuchen, N. J. App. filed Jan. 26, 1907. Means for producing metallized filaments for incandescent lamps. Includes a specially constructed furnace in which the filaments may be subjected to excessively high temperatures for a considerable period of time. Has a graphite tube through which the filaments are impelled in little graphite boats.

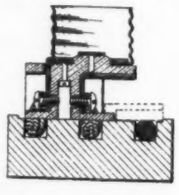
867,528. POINT SHIFTER FOR TRAMWAYS AND THE LIKE; George D. A. Parr, Leeds, Eng. App. filed Aug. 18, 1905. Mechanical construction of a switch point shifter, including a clock-work device released by an electromagnet so as to cause successive actuations of the switch point in alternate directions.



867,391.—Storage-Battery Plate or Grid.



867,236.—Pipe Cap.



867,440.—Three-Wire Molding Receptacle.

867,542. ATTACHMENT FOR ELECTRICAL FURNACES; Samuel M. Weaver and William Ambler, Cleveland, Ohio. App. filed Sept. 29, 1905. Relates to attachments for electrical furnaces employed by dentists in baking porcelain fillings for crown and bridgework. Is especially designed for use with a thermo-pile.

867,543. FILLING FOR THERMAL CUT-OUTS; F. H. Weston, Schenectady, N. Y. App. filed April 22, 1905. An absorptive filling for thermal cut-outs consisting of granules or pellets of slaked lime and a binder.

867,544. ELECTRIC ARC LAMP; Edward F. Winfield, Los Angeles, Cal. App. filed March 14, 1905. Devices for supporting and adjusting the movable or upper carbon of a lamp. Includes a form of disc clutch with tubing link connections to the operating magnet.

867,547. STARTING DEVICE FOR ALTERNATING CURRENT MOTORS; William C. Yates, Schenectady, N. Y. App. filed Oct. 18, 1905. Relates to control of alternating current motors and has a device for starting motors of the induction type and bringing them up to running speed.

867,561. MEASURING INSTRUMENT; Albert G. Davis and Caryl D. Haskins, Schenectady, N. Y. App. filed March 15, 1904. Complete features of construction of a watt meter having means energized from a source independent of the torque of the measuring element to carry practically all of the frictional or idle load.

867,563. AUTOMATIC BLOCK SIGNALING SYSTEM; Daniel J. McCarthy, Wilkinsburg, Pa. App. filed Aug. 16, 1907. A block signal of the type having danger and caution signals and track rails energized by an alternating current in separate block sections. Uses alternating current relays.

12,700. ELECTRIC TRACTION APPARATUS; Alfred Zehden, Frankfort-on-the-Main, Germany. App. filed Aug. 21, 1907. A monorail system in which the cars hang below both sides of a rail supported on standards so that the center of gravity is below the point of support.